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ABSTRACT

As librarians cope with reduced budgets, decreased staff, and increased demands for services, microcomputers will take a significant role in library automation by providing low-cost systems, solving specific library problems, and performing in distributed systems. This report presents an introduction to the technology of this low-cost, miniature computer and a description of its specific applications in libraries. The use of such computers in circulation, acquisition, serials control, reference, administration, and audiovisual services is covered, and current and probable future uses of the microcomputer in each of these areas are described. References are listed at the end of each chapter, and appendices provide glossaries of computer and library terms and a list of vendors supplying automated library systems. (Author/JD)

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Microcomputers in Library Automation

George A. Simpson

MITRE Technical Report 7938

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COVER:
The engine is symbolic of technology which is pulling the library in to the future. The librarian is looking down the track to be sure the way is clear.

Illustration by James Neal

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ABSTRACT

As librarians cope with reduced budgets, decreased staff, and increased demands for services, microcomputers will take a significant role in library automation by providing low-cost systems, solving specific library problems, and performing in distributed systems. An introduction to the technology of this low-cost, miniature computer and a description of its specific applications in libraries are presented in this report.

The application of computers to the library's functions of circulation, acquisitions, serials, reference, administration, and audiovisual services is covered. Current and probable future uses of the microcomputer in each of these areas are described.

Appendices provide glossaries of computer and library terms and a list of vendors supplying automated library systems.

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The floppy disk was then taken to a Unified Composer and Videosetter where another microcomputer captured the machine-readable information and produced galleys for use in the preparation of camera-ready art by the printers.

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EXECUTIVE SUMMARY

Microcomputers are relative newcomers to the library automation field. They offer librarians the ability to automate at costs which are lower than they have ever been. However, it is not generally known what a microcomputer is and how it performs. This report reviews computers already in libraries and identifies roles for the microcomputer.

Teamwork in the Library

Past experience has shown that successful library systems are only possible when librarians and technicians work together as a team. Computer technology, and now microcomputer technology, are going to create many new products in this field. Therefore, it is imperative that both the librarian and the technician understand as much as they can about each other's expertise.

In addition to identifying roles for the microcomputer in library automation, it is hoped that this report will provide both the librarian and the technician with insights into each other's domain. Obviously, in a report like this, it is not possible to investigate two such complex fields as library science and computers in any depth. However, the report should give each group a basic understanding of each other's field, which should aid mutual communication and, in turn, promote the use of microcomputer technology in libraries.

Microprocessor or Microcomputer

The term "microcomputer" is closely allied to the term "microprocessor." The devices are similar, although there is a technical difference between them. This difference is identified in Chapter 3 of this report. For simplicity, we will generally refer to both by the term "micro." This abbreviation is common today and makes sense, because most of the time we will be only interested in the fact that a product contains a micro. Whether the micro is a "computer" or a "processor" will seldom be important to us.

Everyday Uses of Micros

To illustrate some everyday uses of micros, consider a typical early morning of a hypothetical librarian, Ms. Jones. She cooks her breakfast in a microwave oven, drives her late model car to work, stops for gas at an electronic gas pump, is delayed at traffic lights and, on the way to her desk, passes the new Xerox 3400 copier. Like most people, Ms. Jones is probably unaware that a micro was involved in each of these products. Even if she does know, it is unlikely to interest her. She is probably more concerned with the product's ability to function efficiently than with how it works internally.

A similar analogy could be used in library automation. We could say that librarians will be more interested in products which get the job done rather than the technology used. While this is partially true, vendors are not yet at the stage where they can produce these products without the help of the librarian. Therefore, the more the librarian knows about the capabilities and limitations of technology the better will be the products which eventually emerge from industry.

Library Applications for the Micro

Although the microcomputer offers little competition to larger computers in computing power and speed, designers everywhere have capitalized on the micro's strengths of versatility, small size and low cost to produce a variety of products. In many cases, these products would not exist today without the micro, because the same design using other methods would be too large or too expensive.

Most automated libraries already use micros in some of their products and several vendors have announced new micro-based equipment and systems for the library market in 1979. A review of these library applications shows that micro uses may be grouped into one of three categories.

In the first category, a micro is hidden inside the piece of equipment it is controlling. Examples are light pens, portable circulation units for bookmobiles, and intelligent terminals.

In the second category, a single micro controls an entire system. Examples on the market are an automated circulation control system, a cataloging system, and an audio-visual system.

In the third category, several micros are interconnected to rival the power of a larger computer. This technique is called "distributed processing." It is being implemented elsewhere but has not yet reached the library.

Distributed processing should allow each library department to have its own computing power, which will be a first step towards the long-awaited goal of affordable, full automation within a single library.

In all three categories the micro has been used in a problem-solving role. More and more, when designers have a problem they think of micros as a likely solution. Examples are given throughout this report of library systems in which micros solve problems.

The Upsurge in Competition

Since its inception in 1971, competition from this small computer and the technology which created it has reduced prices for all classes of computers. As prices dropped, new markets appeared which increased sales for computer manufacturers. Increased sales encouraged newcomers to enter the field and prices were reduced further. With each succeeding drop in prices, customers who could not previously afford automation became the next market for computerized products. In the late 1970s, the library community emerged as a new market for automation. Competition between vendors is keen and a wide variety of products exists. But one of the questions librarians are asking is, *"With reduced budgets, what kinds of automated systems can we afford?"*

Effects of Politics on Automation

In 1978, California passed Proposition 13. Among its other effects, it reduced local funds available for library services. Other states are expected to pass similar legislation, which means that local governments will have to function with less money. The message from the people is, *"Cut out the waste and inefficiency and give us value for our money!"*

The results of a poll taken by the *Los Angeles Times* after Proposition 13 should be encouraging to librarians. Citizens were asked to place priorities on seven public services: fire, police, libraries, schools, transportation, recreation, and welfare. Libraries were placed just behind fire and police protection, which indicates the importance that the public gives its libraries.

Libraries can respond to that vote of confidence by streamlining their operations to provide the best possible service to their patrons. For many libraries, this means recognizing that manual systems are labor intensive and therefore outdated. As the demand for services will probably increase as it has in the last few years, one of the few ways libraries can cope at a time when budgets and perhaps staff are being reduced is to automate.

Therefore Proposition 13 and similar movements are not likely to eliminate all plans for automation. Rather, there will be a need to investigate lower cost alternatives. Most vendors recognize this, and already have plans for systems developed around micros.

Organization of the Report

This report has been written for both technicians and librarians who will be cooperating to further library automation. We assumed that both audiences will be interested in the whole report, so we avoided the use of schematics, block diagrams and technicalities such as MARC tags and cataloging rules. Instead, we tried to be informative without being too simplistic or too detailed.

The main body of the report presents a general overview of library automation, with details on microcomputer technology and a discussion of computer applications in each department. Existing or potential roles for micros are mentioned throughout, and a chapter is included which identifies considerations for selecting a system. Finally, some technologies which are likely to affect our libraries in the future are discussed.

Appendices are included which provide details on abbreviations used in the report, a glossary of computer terms, and addresses of vendors.

CHAPTER 1

INTRODUCTION

Library automation is a term librarians have been hearing for over twenty years. Yet the majority of libraries still do not have a computer on their premises or a computer terminal at their disposal.

Early computerized systems were developed by a select few and seven figure budgets were not unusual by the time these systems were finished. The remainder of the library community watched with interest, but was uninvolved.

Turnkey Systems

Minicomputers entered the library in the 1960s, but affected very few libraries. In the mid 1970s when private companies offered packaged or "turnkey" automated circulation control systems, more libraries, especially public libraries, became interested. Buying library automation was not all that different from buying a car. All the library staff had to do was to learn how to "drive" the computer—the vendor took care of everything else. Instead of a seven figure budget for automation, it dropped to six figures. However, there were still many librarians who considered the cost of automation beyond their reach.

Microcomputers

Microcomputers slipped almost unnoticed into library automation in the late 1970s. The computer industry had created a miracle, in that the calculating part of a computer had now been shrunk to the size of a shirt button. Computer power was now small enough to be inside the device it was controlling. Devices, such as light pens at circulation desks had small computers inside them. By 1977, a complete circulation system could be bought for $30,000 with a micro. The cost of library automation was now down to five figures.

With new micro systems in the affordable range, one would have expected a large demand from librarians. This has not been the case. The new technology appears to be lost among the many computerized systems being offered to librarians. For example, there were over 30 exhibitors of automated systems covering all departments in the library at the 1978 Summer American Library Association (ALA) in Chicago. Librarians are being inundated with sales literature and are perhaps unsure which product to buy first or which system will benefit their patrons most.

General Objective

In this report we do not propose to grade systems so that librarians can select the "best buy." We do plan to put the microcomputer into perspective as a real contender for library automation applications. The more knowledge librarians have about microcomputers the easier it will be for them to select systems best suited to their needs. We also intend to review library automation for those unfamiliar with developments over the last 20 years. By reviewing the library, department by department, we will demonstrate the scale of library operations for non-librarians and at the same time identify roles for the microcomputer.

Previous Reports on Library Automation

Previous reports on library automation have seldom discussed the microcomputer or its role in library automation. This is understandable as the microcomputer is a recent newcomer to library automation. Those who have mentioned microcomputers have cited their various uses outside the library with interest. Their predictions that micros would have a role to play in the library are being fulfilled and we will identify specific roles in this report.

CHAPTER 2

COMPUTERS SERVING THE LIBRARY

Ever since the computer was first developed, visionaries have forecast computers as being suitable for library applications, and the passage of time has proved them correct. But the computer was not accepted in the library as fast as this was originally predicted. In fact, until 1977 it was easy to think that there were probably more books and articles written on library automation than there were computers in libraries. This impression was easily made when one perused the long list of references at the end of each book or article written about library automation.

The situation is now changing for the better. For example, during 1977 and 1978, a number of vendors delivered about 100 minicomputer-based turnkey automated circulation systems to libraries. In the same period, customers of OCLC (Ohio College Library Center), an online cooperative cataloging service, doubled in number from around 700 to 1400. Acquisition systems also started to gain popularity with online turnkey systems being offered for sale by vendors.

Microcomputer-based systems also appeared in libraries, mainly in cataloging and circulation departments. As of late 1978, only about a dozen of these micro systems were in use. However, equipment such as light pens and intelligent terminals, which contain micros in a supporting role, have had more widespread use. About one thousand micros are used in these products.

Definition of Library Automation

Automation is described in the *American College Dictionary* as "the science of operating or controlling a mechanical process by highly automatic means, such as electronic devices." In a modern library, these electronic devices are most often computers. Therefore, when the term "library automation" is used in this report, it describes a library function which is assisted or controlled by a computer.

When the term "library automation" is used in this report it describes a library function which is assisted or controlled by a computer.

A modern example of library automation is a circulation control system which uses a stand-alone computer located in the library. The majority of circulation functions are handled by the computer and manual processes are kept to a minimum. In this example, it is not the library that is automated; it is only the function which is automated.

Online and Batch Systems

Computerized library systems are either online or batch. Most new systems tend to be online or use a combination of online and batch techniques. A brief description of each follows.

Online Systems

Online systems provide a response in 1 to 5 seconds to requests for information by the user. Also, when transactions are performed, all appropriate files associated with that transaction are immediately updated.

Online systems also allow a user to interact with the computer. For example, the computer might display on the Cathode Ray Tube (CRT): *"Do you want to look at the next page? Enter Y for yes or N for no."* Interactions such as these are only possible with online systems.

Batch Systems

Batch systems accumulate data on magnetic tape, disk or some other means until a batch has been gathered. The tape or disk is then removed, or the data is transmitted, to a large computer for sorting into appropriate files. Information is therefore only as current as the last batch that was processed. Batches are seldom processed more than once a day.

Computer Systems for the Library

We will now focus on the types of computers used in the library and describe some systems which have evolved around the computer. Generally, computers can be regarded as falling into three distinct categories:

1. *Large general-purpose computers (Maxis)*
2. *Minicomputers (Minis)*
3. *Microcomputers (Micros)*

All three categories are now used in library automation. In most instances, other industries proved the technology sound before these computers were introduced to library automation.

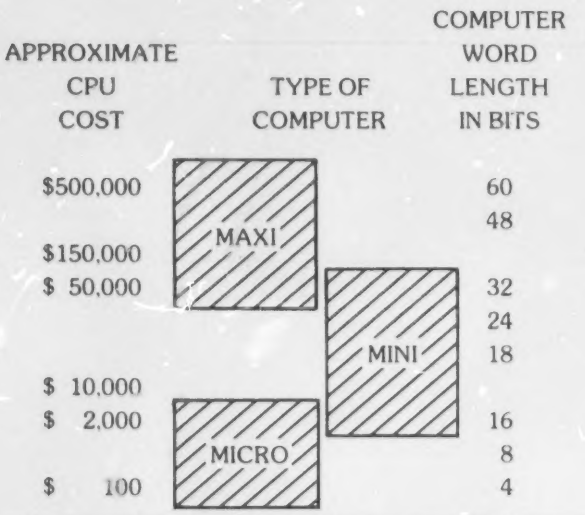
The approximate time frame when each computer type entered the library and two typical models of each are shown in Table 2-1.

TABLE 2-1

Approximate Time Frame When Introduced	Type of Computer	Typical Models Used
Early 1960s	Maxi	IBM 370 SIGMA 9
Late 1960s	Mini	DEC PDP 11/05 SINGER MODEL 10
Mid 1970s	Micro	INTEL 8080 GENERAL AUTOMATION 220

At one time these three categories clearly defined the type of computer within each category. But as technology advanced, the distinctions between minis and maxis and between minis and micros blurred. This is shown in Table 2-2, where the relationship between the three computer types, the cost of the central processing units (CPUs) and the computer word length is shown. Computer word lengths are in bits (binary digits, 1s or 0s) or in bytes (a group of 8 bits).

TABLE 2-2
OVERLAPPING OF COMPUTER CATEGORIES



Computers with long word lengths can handle more complex tasks than computers with short word lengths, and the cost of the computer increases as the word length gets longer.

We will now examine the roles of all three types of computers in the library, starting with the maxi.

General Purpose Computer Systems

The large general-purpose computer (maxi) introduced automation into the library. The first systems were experimental and were installed almost exclusively in large academic libraries with grant funds from foundations or federal agencies.[1] These computers usually belonged to the university or a local governing body and were shared by other departments.

Because of the problems inherent in sharing computers, many librarians recognized the need for their own computer, or at least one that they could access whenever they desired. However, the high cost of computers and the need for programmers on the library staff made many library administrators shy away from automation. Other librarians observed the difficulties experienced by the pioneers and considered the computer unsuitable or impractical for general library applications.

Fortunately for the library community, the efforts of a number of dedicated people have finally paid off. Now maxis play an important role in library automation.

In 1968 the Library of Congress (LC) started distributing cataloging information in machine-readable form on magnetic tapes (MARC). This was followed in 1971 by the Ohio College Library Center (OCLC), a cooperative cataloging venture. These two developments provided libraries with the benefits of computer technology without the need to actually own a computer or to maintain huge data bases.

The cooperative concept changed the way libraries use maxis. Today, newer computer systems are automated services, where the computer and its data base are established for many users.

Table 2-3 gives examples of library functions using automated systems run by maxis.

TABLE 2-3
EXAMPLES OF LIBRARY FUNCTIONS USING LARGE COMPUTERS (MAXIS)

LIBRARY FUNCTION	EXAMPLES OF AUTOMATED SYSTEMS
Acquisitions	BATAB (Baker & Taylor) IROS (Brodart)
Cataloging	MARC (Library of Congress) OCLC (Ohio College Lib. Center) BALLOTS (Stanford University)
Circulation	Batch Systems (Checkpoint) Online Systems (IBM 1030)
Reference	Information Retrieval Systems: DIALOG (Lockheed) ORBIT (SDC) BASIS (Battelle Mem. Inst.) MEDLINE (National Library of Medicine)
Serials Control	UCLA (Biomed) CONSER (LC)

Automated Services

On a subscription basis, many libraries can access a powerful computer simply by connecting their terminal to the computer over a telephone line. These automated services are online, which allows direct communication with the computer.

The existence of all these services, (not all are identified in the table), lends credence to the changing role of the maxi. Although computer costs are dropping, the expense of purchasing and maintaining maxi computers remains prohibitive for most libraries. Some libraries which currently use maxis will probably continue to do so, but it is unlikely that new systems requiring maxis will be installed in many individual libraries.

Minicomputer Systems

Minicomputers entered the marketplace in 1964 with the introduction of the PDP 8 by the Digital Equipment Corporation (DEC). It now was possible to buy a computer for $27,000 instead of the $500,000 required for the large computer.[2]

New opportunities were opened to the library, but it took more than ten years before the minicomputer gained wide acceptance in libraries as an alternative to existing manual systems.

Early Use of Minis

One of the first applications of minis was in libraries which had difficulties using maxis for the circulation function. Delays caused by the local computer center were reduced by having the mini take care of item check in and check out and other circulation functions. The maxi still handled online queries. Even with the minicomputer, the maxi was not always available when wanted, but at least patrons were no longer delayed at the circulation desk. A mini used in this fashion was called a Front End Processor which was connected to the host maxi by a cable.

Libraries located more than a few hundred feet from the host computer had their minis connected to the host computer by a leased telephone line. Such systems were called Remote Concentrators, because data were concentrated and processed by the mini before being sent to the host computer. Most of these systems were developed and programmed by computer experts on the library staff, or by people on loan from the local computing center. Under these circumstances only large libraries could afford the luxury of automation. In addition, each library system differed from every other one as every designer and programmer tackled problems in their own way.

Mini Turnkey Systems

In the mid-1970s, vendor-designed turnkey systems started appearing in libraries. These systems were developed by entrepreneurs from the computer world and eliminated the need for people with programming experience on the library staff. The vendor supplied the equipment, already programmed to the library's requirements, and took care of all maintenance and training. The library staff ran the system and dealt with minor malfunctions.

These turnkey systems were primarily for circulation control with the promise of add-on modules for acquisitions, accounting, serials control and other functions. As of late 1978, MITRE estimates that between 100 and 200 minicomputer-based turnkey systems are operational in libraries. When one adds the branches supported by these systems, the number of libraries using automated circulation control approaches one thousand.

Table 2-4 shows the types of mini systems used in the library, their major features, and the library functions they perform.

TABLE 2-4

TYPES OF MINICOMPUTER LIBRARY SYSTEMS

1. Stand-Alone (no large computer)

Type of Mini System	Major Features	Library Functions Performed
Batch	• Lowest cost • No immediate access to data	Acquisitions Circulation Serials Control
Online	• Immediate access to information	Acquisitions Bibliographic Search Circulation Serials Control

2. Composite (Both mini and maxi computer)

Type of Mini System	Major Features	Library Functions Performed
Front-End Processor	• Mini located close to large computer (host) • Full capability	Acquisitions Bibliographic Search Cataloging Circulation Serials Control
Remote Concentrator	• Mini located remote from host computer • Highest cost • Full capacity	Acquisitions Bibliographic Search Cataloging Circulation Serials Control

Microcomputer Systems

Microcomputers are relative newcomers to the library automation scene. This third generation computer has opened up new opportunities for library automation, because of the micro's small size and relatively low cost.

A technique called Large Scale Integration (LSI), developed in the 1960s, led to the first micro on the market in 1971. This was a computing device used in calculators.

The concept of small computers inside the equipment they were controlling changed the way computers aided automation. Earlier even minis were the size of filing cabinets and required a special area for their operation. With the microcomputer, the equipment became portable. It required only standard 110V electrical power.

Micros in the Library

As micro technology advanced, the micro was able to accomplish tasks only a minicomputer could do before. In fact, some micros have advanced so much that manufacturers are now calling them minis in their sales literature.

Micros are currently in libraries which have automated circulation, acquisition, cataloging, or audiovisual (AV) systems. Micros are either supporting other systems or are operating as the central controller.

Micros are used in supporting roles inside light pens, Optical Character Recognition (OCR) wands, data conversion units, and intelligent terminals. A description of each of those devices is included in Chapter 3.

Systems which use the micro as a computer are automated circulation systems, a system which aids cataloging, and an AV system. Descriptions of these systems are in Chapter 4.

Special Systems

With the introduction of the mini, many libraries gave up their in-house computer capability and relied on vendors to produce automated systems for them. With the micro, however, many librarians are intrigued to discover that they can purchase a small packaged computer ready for programming for around $1,000.

For example, Dr. Theodore Hines at the University of North Carolina at Greensboro is experimenting with a subject retrieval system for children's books which can be run on such a system. Other librarians are developing systems to solve local problems. Once the capabilities of micros are more widely recognized this trend is sure to increase. Micros are also ideal for use as small business computers by the administrative department for handling payroll, personnel and other functions.

Library Computers in Perspective

Libraries have used all three types of computers to supply better service to their patrons.

Maxis perform best where large data bases need to be maintained and presented online, as in cooperative systems where many libraries access a common data base. Information retrieval and cataloging have been the main beneficiaries of the maxi.

Minis give libraries the opportunity to have their own in-house computer capability. Medium-sized data bases can be stored on minis and online interactive systems are possible. Circulation, acquisitions, and serials are best suited for mini-systems.

Micros offer new ways to solve old problems. They provide low-cost systems which would be impractical without the micro. In supporting roles the micro will appear in every department in the library. However, circulation, cataloging, audiovisual and administrative departments will probably continue to benefit from systems designed around microcomputers.

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CHAPTER 3

MICROCOMPUTER TECHNOLOGY

Since the advent of the microcomputer, a whole new technology has developed which has revolutionized the computer industry. These developments have been rapid, so we will review that technology before we proceed further. We will start by asking, *"What is a microcomputer?"*

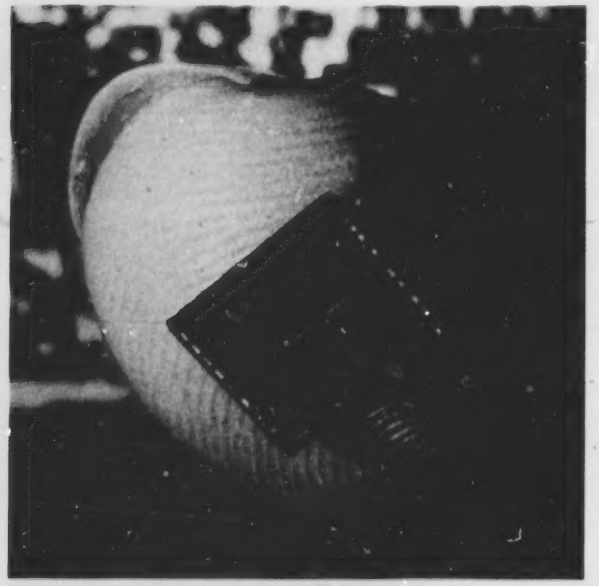
It is tempting to answer that the microcomputer is just another computer, except it is smaller and less expensive than a mini or a maxi. But to do that is to ignore an important application for micros—process control. The microprocessor is already fulfilling a number of roles in library automation which will be identified later.

We will show how the microprocessor has a different but similar role to the microcomputer in library automation. We will also discuss terms such as software, memory, storage, and other technical terms that the librarian who installs automation is likely to encounter.

We will distinguish between the microcomputer and microprocessor where appropriate in this section. However, elsewhere in this report we will continue to use "micro" to mean either a small computer or a processor.*

The Microprocessor[1]

In 1969 a company called Intel, under contract to Datapoint Corporation, developed a computing unit on a single logic chip. Unfortunately, the device did not perform according to specifications and Datapoint declined to purchase the device. Intel was left with the product and had a decision to make: discard the device or sell it. They chose to sell it, and in 1971 the first microprocessor went on the market.



Intel's 8748 Microcomputer Substrate Chip. (Photograph courtesy Intel Corporation).

A microprocessor is basically the central processing unit (CPU) of a computer shrunk in size until it can be held in the palm of one's hand. Yet its computing power is greater than the original Eniac computer which weighed nearly 30 tons, occupied 15,000 square feet of floor space, and contained over 19,000 vacuum tubes.[2] A modern microprocesor also costs little more than one vacuum tube in the original Eniac computer.

A microprocessor is basically the central processing unit (CPU) of a computer shrunk in size until it can be held in the palm of one's hand.

Microprocessor Technology

The new microprocessors were developed using a technology called Large Scale Integration (LSI) in which thousands of transistors are connected on a substrate of silicon. Previously, the manufacture of electronic devices was very labor intensive and expensive. With LSI, almost the entire process was automatic. As manufacturers perfected techniques, the prices dropped. For example, calculators which once cost $100 now sell for less than $10.

Technically, microprocessors come in three different configurations as shown in Table 3-1.

TABLE 3-1
APPLICATION OF MICROPROCESSORS BY WORD LENGTH

Microprocessor Word Length (Bits)	Typical Application
4	Calculators
8	Controllers
16	Computers

The designer chooses the word length depending on the application. If, for example, the application will control the functions of a terminal at a circulation desk, an 8 bit microprocessor could be used. If the microprocessor will be used as part of a computer in a complex system, then the 16 bit version would be the most likely choice.

Microprocessors are generally designed for a specific purpose. The size of the program is limited by the amount of memory supplied by the manufacturer and in many cases is not easily changed. Therefore, microprocessors are used in library automation mainly for small tasks such as light pens or OCR wands.

The Microprocessor as a Controller

In its role as a controller, the microprocessor operates much like a secretary in a busy office. Requests and commands come in all the time. In the office, a

* *Appendix I contains a glossary of computer terms for more complete definitions.*

secretary routes some requests, holds some for later, gets assistance on some questions and answers others directly. The secretary acts as a central controller making decisions based on previous experience. The microprocessor also acts as a central controller, except that its "experience" is a program which it follows mechanically. Such a role by a microprocessor is called process control, meaning a process of some kind controlled by non-manual means.

In its role as a controller, the microprocessor operates much like a secretary in a busy office.

Many uses of microprocessors as controllers in the library are in-line, meaning simply that the processor is in the line between the person using the instrument and the process being controlled. When a librarian at the circulation desk uses a light pen, a microprocessor is between the input at the light pen tip and the output into the computer. The microprocessor transforms information supplied as reflections of light into a machine-readable code which the computer can accept.

Because the microprocessor is small and draws little electrical power, it is usually housed inside the instrument or equipment it is controlling. For this reason, many people are unaware that these devices are being used to control processes. Libraries which use OCR wands, intelligent terminals, word processors, and other automated equipment are already using microprocessor-controlled instruments.

Microprocessor Sources

At least 39 manufacturers supplied microprocessors to industry at the beginning of 1978.[3] Some microprocessors may be purchased from local electronic parts suppliers for as little as $10. These microprocessors are often single chips. Their circuit is inside a small package with two rows of connecting pins along each side.

Designs which use microprocessors are made by industry and finished products are used by the library. Products which currently fall into this category are light pens, OCR wands, and intelligent terminals. It requires a lot of skill to take finished products and assemble them into a system like a circulation control system. Although some libraries have assembled their own components, the majority prefer to let a vendor supply a turnkey system for their needs.

When one takes a microprocessor (CPU) and adds certain electronic parts, such as memory and input/output circuits, a microcomputer is the result.

The Microcomputer

When one takes a microprocessor (CPU) and adds certain electronic parts, such as memory and input/output circuits, a microcomputer is the result. With additional memory, the microcomputer can handle larger, more complex, tasks. Input/output circuits permit the microcomputer to work with other equipment such as keyboards, light pens, or printers. With this expanded capability microcomputers are able to perform in systems such as aircraft guidance, ship navigation, and circulation control systems.

Microcomputer Sources

Microcomputers come from three main vendors: those who sell the basic electronics; those who sell commercially packaged microcomputers; and those who sell personal computers.

In early 1978 there were at least 14 vendors supplying chips to industry for use in microcomputers. These chips are basic components, and although advertised as "a computer on a chip," they still need additional parts and programming to be useful. Chips sell for about $30 each, or less than $10 in quantity. Basic components are mostly used by vendors who are building larger systems or enthusiasts who want to build their own systems. As with the microprocessor, it is unlikely that library staff will want to become involved in design at the chip level, although it is not impossible.

Commercial Systems

Commercial systems can be either turnkey systems designed for a specific purpose, such as an aid to cataloging, or basic microcomputers fully assembled but unprogrammed. The unprogrammed systems sell for less than $1000 to more than $10,000. Systems priced below $1000 are usually offered by new vendors in the field. The long-term reliability of this equipment has not yet been proven for library applications.

Other commercial sources are established computer manufacturers. An example is the microNova system from Data General. For $10,970 the buyer gets a microcomputer, a dual floppy disk system, a terminal with a printer, and a cabinet. System software support is also supplied to help write programs. Systems from established vendors are more expensive than those supplied by new companies, but they are currently considered to be more reliable.

Data General's microNOVA Computer System.

Personal Microcomputers

Personal computers can now be purchased at computer stores in local shopping centers. These personal computers are microcomputers packaged into a system along with a keyboard and a CRT. The price varies from $429 to $1899 depending on the capabilities provided. The average cost is $1000. Buyers can select from 17 different manufacturers' products as of late 1978.[4]

There will no doubt be a number of computer enthusiasts who will design small library systems using personal computers. Because of the low cost of these products it will be possible to test new library concepts without investing large sums of money. However, these activities will probably be limited to special and academic libraries who have staff members with data processing backgrounds.

There will no doubt be a number of computer enthusiasts who will design small library systems using personal computers.

It is predicted that the personal computer industry will ship 1.2 million units annually by 1982.[5] As these computers become more commonplace, it is not unreasonable to expect patrons to want to access a library's collection from their homes by the telephone. More will be said about this later.

Microcomputer Support

Librarians who install automated systems in their libraries will continually hear terms like memory, storage, software, and I/O (input/output). In this section we will explain these terms and show how they are used in computer systems.

Microcomputer Memory

A memory in a computer holds information for immediate and future use. Programs which control the computer are stored in the memory along with data entered by light pens, keyboards, or other methods of data entry.

Memories associated with microcomputers are either ROM (Read-Only Memory), RAM (Random Access Memory) or EPROM (Eraseable Programmable Memory). For those who wish to know more about the distinctions between these memory types, references are included at the end of this section.[6,7,8]

The ROM, RAM or EPROM memories supplied with the microcomputer are seldom large enough for most library applications. Therefore, additional memory is usually required and is obtained using a concept called storage.

Storage

Library systems usually require large amounts of storage because bibliographic records require many bytes of data. The number of transactions is usually high which also requires many bytes of data.

Storage is usually provided in the form of floppy disks, hard disks, magnetic tapes or plug-in semiconductor memory.

Libraries which use turnkey circulation systems will already be familiar with disk drives and magnetic tapes. Disks are used to retrieve records from storage in a few seconds and magnetic tapes are often used as security or backup for the data on the disks.

Table 3-2 identifies four typical types of storage medium and an approximate cost for storage systems.

TABLE 3-2
TYPES OF STORAGE

Storage Medium	Typical Memory Sizes in Bytes	Approximate Cost $
Plug-in Semiconductor P.C. Board	16-32 Thousand	1500
Dual Floppy Disk and Controller	0.6-1.0 Million	2000
Hard Disk and Disk Drive	5-10 Million	4500
Magnetic Tape and Drive	5-40 Million	7000

Floppy disks are about the size of 45 rpm records and are physically quite flexible. This storage medium is popular in microcomputer systems. Floppy disks can store about 2000 full MARC records on each recording side. A dual floppy system could therefore store 8000 records (both sides of 2 disks).

Floppy disks are about the size of 45 rpm records and are physically quite flexible.

Memory Technology in the Future

Memory technologies are now being developed which will expand the capabilities of microcomputers. They will be briefly discussed here. They are mentioned more and more in the literature.

Bubble Memories

It is predicted that bubble memories will make fixed head disks obsolete by 1983.[9] Bubble memories are extremely reliable. They have the ability to store data for more than a century without degradation.

The capacity of these memories is also expected to increase. Current bubble technology allows 100,000 bits of information to be stored on a single chip. By 1982, their capacity is predicted to increase to 250,000 to 500,000 bits. Prices are competitive with disks, so their use is likely to increase.

Charge Coupled Devices

Charge Coupled Devices (CCDs) are another solid state memory likely to appear in microcomputers. Some manufacturers have already replaced their RAMs and ROMs in some computer systems with CCDs because of the CCDs higher bit density and lower cost per bit.[10] Typical storage is 65,000 bits of information on a single chip.

Video Disks

Video disks are still in the prototype stage and have not yet reached production. These disks resemble grooveless long-playing records and can store 40 billion bits of information. A single disk could store the entire contents of the latest *Encyclopedia Britannica* with room to spare. These disks are projected to cost around 60 cents each. They are rugged and can be mailed or stored without damage. The introduction of this memory storage technology is certain to have an impact on library automation.

Input/Output (I/O)

Other terms often heard by librarians with automated systems are the I/O and the computer bus. The I/O relates to the number of ports which are available from the computer. These ports allow terminals, CRTs and other input or output devices to be connected to the computer. Therefore, the I/O is the means by which one communicates with the computer. For example, the input may come from keystrokes at a terminal asking for a list of all the titles by a particular author. The output may be a display on a CRT of all the author's works held by that library.

There is a limit to the number of I/O ports available from the computer. If all the ports are in use the response time from the computer is slowed. Librarians should question vendors about the capabilities for I/O before systems are purchased, or expansion of the system may become prohibitively expensive.

Computer Bus

The computer bus refers to the connections and voltage levels at the I/O ports to which terminals or CRTs are coupled. These levels are listed in a bus standard used by the manufacturers. Some typical standards are: RS-232, S-100 or ASCII.

Bus standards are important where librarians wish to purchase additional terminals to connect to existing systems. New terminals must be compatible with existing standards or the system will malfunction.

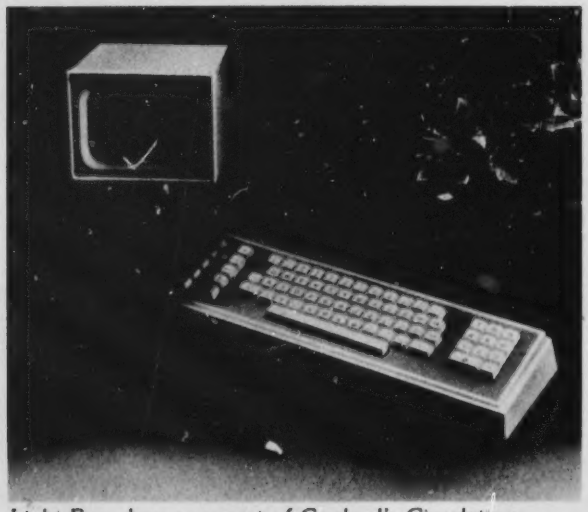
Bus standards are important where librarians wish to purchase additional terminals to connect to existing systems.

Peripherals

When automation is installed in a library, patrons will probably not see the actual computer. Patrons will see peripherals, pieces of equipment which are not part of the computer but are needed to complete the system. Examples of peripherals are keyboards or light pens which are used to get information into the computer, cathode ray tubes (CRTs) or printers which present information from the computer, and disk or tape drives which store information for future use by the computer.

Light Pens

When an automated circulation system is installed in the library, every item (book, journal, etc.) has to be given an identification number that can be read by a machine as well as by a human being. One popular method is a bar-encoded label, which contains a series of black lines with spaces between them, and below that, the decoded number. These labels have been dubbed "Zebra labels."



Light Pen shown as part of Gaylord's Circulation Terminal.

Devices which optically read these bar codes so that the computer recognizes the number are called light pens. A light pen looks like a pocket flashlight which has a light bulb at one end and a cord dangling out of the other. The person at the circulation desk lightly draws the pen across the label. If the operation is satisfactory, the operator is greeted by an encouraging "beep."

The light bulb in the pen is an optical source which directs light on to the label. Reflected light from the label is converted into electrical signals and passed up the cord to a microprocessor. The microprocessor examines the electrical signals and, using a technique called "parity," decides whether or not to accept the data. Silence is usually a sign that the data have not been accepted and that the operator should try again. Some libraries, however, have reversed the process and prefer a "beep" only when there is a wrong reading.

Wrong readings can occur if the tip of the pen is pressed too hard on the label or if only part of the label is swept by the pen. Sometimes the computer may be busy at the instant the pen is used and the input may be ignored. The microprocessor simply rejects all wrong readings and waits for the person to try again.

OCR WANDS™

Optical Character Recognition (OCR) is another method used for machine reading of labels. The labels use numbers and a few selected letters of the alphabet rather than Zebra labels. Some libraries prefer this method because they can produce their own labels on a typewriter using a special OCR font ball on an IBM typewriter.

The OCR WAND™ consists of a hand-held unit containing a light source, and an electronics module which houses the microprocessor. The system operates like the light pen in that reflected light from the label is presented to the microprocessor as electrical signals. Validation of data is more complex, however, as letters as well as numbers are present. Acceptance of the data triggers a "beep." Silence signals a wrong reading. Operators require more training with this system as it requires a smooth, parallel pass over the label to get a successful reading. Best results are obtained by holding the above unit slightly above the label, which requires a certain amount of dexterity.

Because OCR technology allows for letters and numbers, it might be thought that Dewey call numbers could be used on the labels. This is not possible, because all the letters of the alphabet are not available in this system. Therefore, a new identifying number must be assigned to each item in the collection when using OCR.

Touch Sensitive Displays

Television-like displays can be used in the library to present information to the librarian or the patron. Until recently, it was necessary to use a typewriter-like keyboard to interact with the computer. Now, by merely touching a specific area on the screen the computer will provide the operator with the information requested.

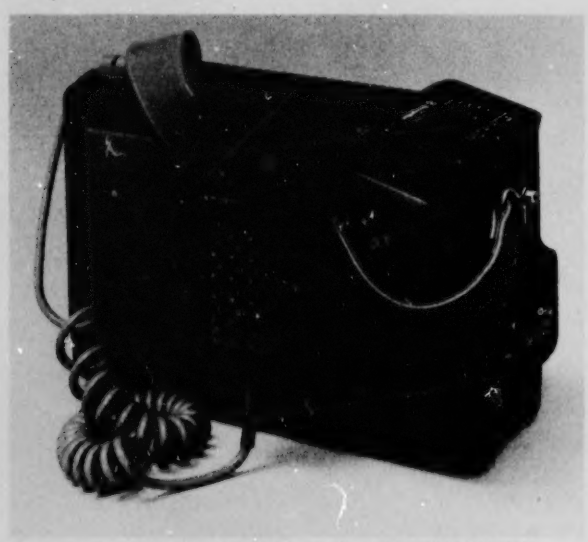
A grid structure of vertical and horizontal lines on the face of the screen is connected to a microprocessor which interprets the touch-command and instructs the computer to comply with the request. Further questions to the operator, or answers from the computer, are displayed on the screen along with instructions on where to touch the screen. For example, a question might be, "Do you want to search by author or title?" Touching "author" produces another display which further instructs, "Touch the section that contains the author's last name." Touching one of the choices presents a new display. If the author desired is not on that screen, the next grouping is requested. This continues until the correct author is located, at which time all works held by the library by that author can be displayed.

The system is easy to use and requires little training. This is important for systems which are available to all patrons. However, because of the novelty of the

system, people, especially children, are likely to spend more time at the display. This may cause lines and delays. Only time will tell if the novelty diminishes so that people will use the display only for an immediate need.

Portable Units

A number of manufacturers have developed portable circulation or inventory control units. These portable units contain a light source, a microprocessor and a cassette tape. They are totally self-contained and may be battery operated. Portable units are used for applications such as recording circulation on bookmobiles, substituting for the main computer during power failures, or taking inventory.



Recognition Equipment's Portable OCR WAND™ Terminal incorporates a hand-held optical reader with multifunction keypad and LED display, minicassette recording unit and nickel-cadmium battery pack into one lightweight package to be worn at the waist and supported by a shoulder strap.

Information is collected from machine-readable labels by the light pen or OCR WAND™. If the data are valid, the microprocessor signals the operator with a "beep" and records the data on the tape. With each operation the tape advances a small amount and then stops, awaiting the next input. When the tape is full, the operator is alerted that a new cassette is required. Once the task is complete, the data on the tape are fed into the computer at a convenient time for processing.

Data Conversion Units

Automation often brings a time-consuming task to the library: the conversion of bibliographic information into machine-readable form. In many libraries this has required personnel to enter the data manually on keyboards, a task that can take months or years, depending upon the size of the collection.

For libraries which already have bibliographic data on punched cards from a previous system, there is a unit which converts data from one machine-readable medium to another with a microprocessor.

After connecting the conversion unit into the system, simply passing a punched card through a slot transfers the information from the card into the computer without any more manual effort. In the CLSI system, for example, the information appears on the display and can be immediately edited by a operator.

Intelligent Terminals

Terminals are devices through which people can communicate with computers. They contain typewriter-like keyboards and CRTs. Some may also contain printers which provide a hard copy of the data displayed on the CRT.

A terminal becomes intelligent when it contains microprocessors and perhaps a microcomputer which can be programmed by the user. Some intelligent terminals also have the ability to communicate with each other over a telephone line.

Intelligent terminals give the user the ability to push only one key and cause a series of events. For example, in an automated acquisitions system, pushing just one key results in a display of an order form on the CRT. After the order form is filled in from the keyboard, pushing another key automatically transmits the order to a book jobber.

Intelligent terminals in libraries make it easier for librarians and staff to use automated systems.

Software

Programs which supply operating instructions to the system are called software. Programmers write software in machine language, in assembly language, or in a high level language. Table 3-3 identifies some of the characteristics of these programming languages. Machine language is the only one to which the computer responds; therefore, assembly and high level languages have to be converted into machine language using devices called assemblers and compilers.

In microcomputer systems, writing programs for the computer is likely to be the major cost item. Jim McDermott states, "*The big shock comes when the designer gets into microcomputer software. It can cost from hundreds of dollars to thousands for the finished system. For a $30 microprocessor, software has been known to cost $65,000 to $70,000.*"[12]

Software support has not been as well developed for micros as it has been for minis and maxis. The smaller memory size currently available on micros has required high efficiency from the programming language. Therefore, many programs have had to be written in machine language, instead of assembly or high level languages which programmers prefer.

Writing a program directly into machine language is tedious and time-consuming. To solve this problem, such a program is written in assembly or high level language on a larger computer, usually a mini, and a device called a cross-assembler is used to produce a machine language that can be run on the micro.

As memory sizes for micros expand, it is anticipated that high level languages will become available. To date, only BASIC has been widely used, mainly because of its simplicity. But at least six manufacturers plan to develop FORTRAN, COBOL, PASCAL and internally generated versions of these languages by the third quarter of 1978.[13] These developments will make programs for microcomputer systems easier to write and should bring down the cost of programming.

If a library wishes to modify a program on its microcomputer system, it might be very difficult if the language were not a high level one. Therefore, libraries should inquire about access to their vendor's programs if these programs ever need to be modified. Also, libraries wishing to modify programs should discuss development systems with their vendors.

Development Systems

Development systems are designed to assist in software preparation and are available from at least 34 manufacturers.[14] These systems eliminate the need to write programs on a larger computer and then transfer them to the microcomputer. Techniques called simulation and emulation now assist the designer in programming and debugging microcomputer systems.

It is unlikely that many libraries will purchase development systems unless they have a programming staff who can take advantage of this new technology. However, librarians should still be aware that such products are available. Their microcomputer vendors can inform them how development systems can help modify the library's software.

Future Microcomputer Library Systems

A technique which is likely to have a major impact on library automation is distributed processing. This technique allows several inexpensive microcomputers to work together to equal the performance of a larger computer.

Distributed Processing

Distributed processing spreads the computing load over several smaller computers rather than concentrating all the work in one large computer. Systems have been implemented outside the library using minis, and several systems are in development using micros.

Intelligent terminals contain microprocessors and in some cases microcomputers. When connected, these terminals can form a distributed network. Bubble memories and the additional power they can give intelligent terminals are a possible first step towards distributed systems in libraries. These terminals will be able to do their own processing and pass results to a central controller.

Programmers prefer distributed systems because programs are easier to write and to debug. Another advantage is reliability. If one small computer breaks down, the rest of the system can still operate, although not as well. In a central system, an inoperative computer causes the whole system to go down.

For those interested in learning more about distributed processing, a booklet by Digital Equipment Corporation called *Distributed Data Processing — A Management Guide*[15] explains in uncomplicated terms the full ramifications of a distributed system.

Microcomputers - A Recap

In this section we have seen that the microcomputer performs as both a small computer and as a controller. It is physically small and inexpensive. The technology which was responsible for its development is still expanding, especially in memories. Support for the microcomputer is also advancing with new high level languages and development systems. Distributed processing promises new complex library systems at greatly reduced cost.

TABLE 3-3

MICROCOMPUTER SOFTWARE LANGUAGES

LANGUAGE	CHARACTERISTICS	TYPES
Machine	• Written form is most complex • Code is in binary form • Language is machine dependent • Computer reads directly	A different type exists for each vendor's computer
Assembly	• Written form is rather complex • Code is in mnemonic form • Language is machine dependent • An assembler program is necessary to convert code to machine language	A different type exists for each vendor's computer
High level	• Written form is simpler • Code is in statement form • Language is machine independent • Language is problem oriented • A comiler is necessary to convert from high level to assembly language	PL/I MPL BASIC FORTRAN IV BSAL PASCAL

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CHAPTER 4

AUTOMATION ALTERNATIVES FOR LIBRARY SUBSYSTEMS

Treating library operations as a number of subsystems, as others have done, seems a reasonable way to view the library.[1] No department in the library can be autonomous. Each departmnt supports the others to produce effective service for its patrons. In fact, with automation, many of the traditional boundaries tend to disappear as data base management systems are implemented.[2] It is therefore only for analysis that we break library operations into separate units so that we can determine the role of the micro in each.

Six subsystems or departments appear to be typical for most libraries:

Circulation.

Cataloging.

Acquisitions.

Serials.

Reference.

Administration.

Some libraries also have audiovisual (AV) departments which are automated. We will therefore include a section on AV departments.

Organizational Outline

As we review each subsystem or department in the order it is listed, we will follow the same general outline.

First, we will identify the basic requirements of an automated design for that subsystem. All computerized systems later mentioned (including micros) will be assumed to be capable of fulfilling these basic functions.

Second, we will review the general application of computers to that subsystem to put the role of the micro into perspective. Then we will identify vendors who are actively marketing to libraries.*

Finally, we will identify roles for the micro in that subsystem in terms of current and future applications.

CIRCULATION CONTROL

To the average patron, circulation is simply taking an item to the desk, checking it out, and later returning it.

Overdue notices and reserves are two major problems with manual circulation systems.

*Note: *The inclusion of a vendor should not be taken as an endorsement by MITRE of its product. Also, the exclusion of a vendor should be regarded as an oversight rather than an intentional omission.*

To the librarian, circulation is much more complicated, especially with a manual system. Many librarians do not know exactly what is in their collections. In fact, the installation of an automated system often reveals that collections are 25 percent smaller than the librarians thought. Overdue notices and reserves are two major problems with manual circulation systems. Some of these systems cannot permit one to determine who has an overdue item until six weeks after its due date. Handling reserves under a manual system often means checking piles of books against reserve lists, typing letters and keeping lists up-to-date.

Automated circulation has allowed librarians to regain control of their collections. Overdue notices can be printed automatically the day after an item is overdue, if necessary. Reserves are automatically identified at the circulation desk. The amount of labor associated with circulation has been reduced, which frees the library staff for other, more creative work.

The amount of labor associated with circulation has been reduced which frees the library staff for other, more creative work.

Basic Requirements of Automated Circulation Systems

An automated circulation system should provde at least the following basic requirements:

Automated check out of items.

Automated check in of items.

Allowance for renewals.

A reserve system, with automatic notification that a returned item, or one about to be checked out, is on the reserve list and the name of the patron reserving it.

The ability to identify patrons returning items late at the circulation desk.

The ability to search the circulation record for a desired item and to determine if it is checked out, who has the item, and when it is due back.

Production of overdue notices.

Collection and printing of statistics on collection use.

Additional Features

Some libraries require more features than those offered by a basic circulation system. Of course, additional features usually result in a more expensive system. If the additional features greatly increase the amount of data storage and processing, then the cost may rise considerably. Some additional features available in circulation systems are:

An automatic calculation and display of fines.

A method of registering waiting lists for reserved items.

A large number of patron-borrowing categories.

A CRT display of an online patron registration record.

A way to search the circulation inventory by author, title, call number, or subject.

Types of Circulation Systems

Automated circulation systems presently used in libraries can be categorized under at least one of these major headings:

Inventory Control.

Transaction Recording.

Online or Batch.

For example, some circulation control systems are online inventory control systems and others are transaction recording batch systems.

Inventory Control

With this concept, the entire collection is considered to be an inventory. Bibliographic information of author, title, call numbers, etc., is placed in the computer's data base in machine-readable form. The disposition of each item is maintained by the computer, and when the disposition of an item changes so does its record in the computer. An inventory control system is more expensive to maintain than a transaction recording system, but it provides more current information of circulation records.

An inventory control system is more expensive to maintain than a transaction recording system, but it provides more current information on circulation records.

Transaction Recording

A transaction recording system is different from an inventory control system in that bibliographic records of the entire inventory are not in the computer's data base. Only patron and transaction data are entered into the data base for the duration of the loan. Once the item is returned, all records associated with the transaction are automatically erased from the data base. This system is less expensive to operate and requires less information storage than an inventory control system.

Suppliers of Circulation Systems

Most automated circulation control systems in libraries today have been supplied by vendors. Some systems which were installed more than three years ago are considered outdated as they use punched cards or embossed badges for patrons.

In 1976, a survey compared 8 different automated circulation control sysems on the market: today only one (CLSI) of the systems surveyed is actively being marketed.[3] In 1977 a report compared turnkey minicomputer-based circulation systems from 5 vendors. One of those (3M Company) has since withdrawn its product and has plans to develop a micro-based system instead.

These surveys show that automated circulation control is a highly competitive business. Yet, as companies drop out, others take their place. Two recent entries are shown in Table 4-1 which contains a list of 12 vendors who currently sell, or are trying to sell, systems to libraries. Where appropriate, a user of each vendor's system has been identified. Also included is information which describes the type of system offered.

The 12 vendors shown in Table 4-1 are not the only ones supplying circulation systems to libraries. For example, some small companies design custom systems for libraries; IBM sells, but does not actively market, systems; and a number of libraries have designed and installed their own systems. Because of space limitations we will not describe any of these systems, nor will we describe any minicomputer-based automated circulation systems in this chapter. William H. Scholz has done an admirable job of describing 5 such minicomputer systems in another report.[4] We will include mailing addresses in the Appendices for librarians who desire more information on minicomputer systems.

In addition, Barbara Markuson reviewed automated circulation systems after the ALA Institute in Dallas, Texas in December 1977.[5] She gives sound advice to librarians contemplating the purchase of automated circulation systems and draws attention to four surveys conducted since 1975. It is therefore unnecessary for us to repeat that information here.

Micros in Circulation Control

Micros were introduced into the library inside light pens and OCR WANDS™. Their use quickly spread to display terminals, touch-sensitive displays and data conversion units. These applications are considered supportive, because the micro is used to support the larger function played by the circulation control equipment. However, the micro did not remain in a supporting role for long.

TABLE 4-1
TURNKEY AUTOMATED CIRCULATION SYSTEMS

Source	System Name System Type*	Notes
Checkpoint Systems, Inc.	Module 1B Batch ICS	Installed at Milwaukee County Federated Library
Cincinnati Electronics Corp.	Classic Online ICS	Installed at Univ. of Kentucky Medical School
C. L. Systems, Inc. (CLSI)	LIBS-100 Online ICS	The leader in the United States with 98 installations serving 247 libraries. Installed in Baltimore Public Library
Data Phase Systems, Inc.	ALIS Online ICS	Installed at the Tacoma Public Library and others
Decicom, Inc.	Decicom Circulation Control System Batch TRS	Recently introduced an on-line system. Developed a micro-based system for Nassau County Public Libraries
East Brunswick Public Library	The Library System Online ICS	A system designed by a library
Gaylord Bros., Inc.	Gaylord System Online TRS	Designed for resource sharing. Recently installed an 83 terminal system at Queens Borough Public Library
Knogo/ALS	System IV (batch) System V (online)	Operates in conjunction with a book security system. A U.K. newcomer into the U.S. market
Plessey Ltd.	ICC/Plessey Module IV Online ICS	An advanced online system installed in Canada. A newcomer to the U.S. market although other Plessey systems are in over 400 libraries throughout the world
Systems Control, Inc.	SCICON Online ICS	Installed at San Jose Public Library
Universal Library Systems, Ltd.	ULISYS Online ICS	Installed at Phoenix Public Library and libraries in Canada
University of Toronto Library Automation Systems (UTLAS)	The CIRC System Online ICS	Operates as part of a distributed processing network

*Note

ICS = Inventory Control System

TRS = Transaction Recording System.

First, in 1975, there was a transaction recording, batch-process system designed by Decicom Systems, Inc. of Farmingdale, New York which required the use of a larger computer for file manipulation and report generation Then, Cincinnati Electronics displayed their micro-based system at the 1978 Summer ALA Conference in Chicago. This was also a transaction recording system, but by using dual floppy disks it operated online and did not require a larger computer. This new product will be offered for sale in 1979.

A brief description of these two systems follows:

The Decicom System

Initially, Decicom designed their micro-based system to meet the needs of libraries in the Nassau County library system. The requirement was to design a low-cost automated circulation system which could take advantage of an existing centralized data base. This data base contained bibliographic information which was entered for acquisition purposes and still stored in the county computer. The problem was how to best exploit the existing data in the large computer which represented a machine-readable record of the collection. Nassau County did not want to transfer the data to another computer, nor was it prepared to edit the data for use as a patron catalog in an online system.

Decicom worked with the library staff to develop a system which would solve the problem. Their solution was to give every item in the 275,000 item collection a unique 6-digit number which identified the item, the library owning it, and the Dewey classification for it. These unique numbers were added to the central computer files so that bibliographic information for each item was retrievable by simply matching two numbers.

Decicom's circulation terminal being used to check out books. Note the tape drive located under the desk.

The system uses a 16 bit microcomputer card from National Semiconductor and was described in an article entitled "Library Picks Micro over Mini As It Automates."[6] Decicom's batch transaction recording system costs $30,000 and records circulation data on a 9-track magnetic tape for subsequent file merging and updating by the County's Univac computer.

A further development at Decicom is an online, inventory control system using a General Automation 16 bit microcomputer. This system promises subject search and display of an abbreviated catalog.

A Stand-Alone Micro System

Cincinnati Electronics Corporation plans to market a stand-alone transaction recording system in early 1979. This is the first stand-alone micro system announced for circulation control. The basic system consists of a tabletop unit and an existing circulation terminal. The tabletop unit contains the micro, a keyboard for data entry, an 80 column thermal printer for reports, a 32 character plasma display for operator messages, and two floppy disks. Additional equipment includes a staff inquiry terminal (CRT and keyboard), up to four more circulation terminals, a line printer, magnetic tapes and larger disks. Target price is $30,000 for the basic system; $50,000 with all the options.

A major advantage to this system, apart from its lower cost, is that the services of a computer outside the library are not necessary. The system also operates online, for each transaction will immediately update the files.

Bibliographic data are not kept on the disks, so it is not possible to display an online abbreviated catalog for searching by author or title. Searching by call number is possible though, and any item not listed in the computer should be presumed to be on the shelf or lost.

Bookmobiles and Micros

Bookmobile circulation has posed a problem in the past. In early systems, bookmobile data were kept manually during the day and input to the computer at night. With the advent of the micro, portable circulation terminals for bookmobiles have since been developed. The micro keeps track of all transactions and stores the information collected during the bookmobile's tour of duty. Some systems store the data on tape cassettes; others use semiconductor memory.

After the bookmobile returns to the library, the data collected in the portable circulation terminal is fed into the library's main computer for file updating. Using this method, the bookmobile functions much like a branch which updates the files once a day in a batch mode.

Some libraries would like to be able to place reserves from the bookmobiles when they are requested. This way they can inform the patron immediately of the status of an item and provide information about the waiting list. This can be accomplished using the telephone, but at least one library (Maryland's Montgomery County Public Library) is investigating the feasibility of using a mobile radio link for this purpose.

Cincinnati Electronics Microcomputer-Based Circulation Control System. Left-to-right, Integrated Unit of: CPU, Keyboard, Floppy Disks, 32 Character Display, 16 Function Keys, 30 Char/Sec Printer; a JRL-1000 Circulation Terminal with Light Pen and a CS-350 Staff Terminal.

Future Roles for the Micro in Circulation Control

As we have seen, the micro has already filled supporting roles in automated circulation control and has been successfully used in transaction recording systems. The application of the micro to solve problems and create low-cost systems has been demonstrated.

Another role likely to be implemented is a distributed processing system using a combination of micros and one mini. The 3M system, which was being installed in the Arlington, Virginia Public Library and in Princeton University, used this concept before its withdrawal. It was to be an advanced online inventory control system, but could not be implemented at what the 3M Company considered a competitive price.

Future distributed systems are likely to appear in libraries initially from established companies who view the micro as a natural addition to their existing product lines. As Walter Winshall, president of CLSI, remarked, *"We see these devices being appropriated in single processor configurations for small libraries, as well as in multi-processor configurations for large libraries and library systems. The multi-processor architecture in large library systems provides for modularity, reliability, and response time independent from the amount of transaction activity generated at the terminals."*[7]

The multi-processor architecture in large library systems provides for modularity, reliability, and response time independent from the amount of transaction activity generated at the terminals.

Another company, Gaylord Brothers, Inc., has announced plans to develop a distributed processing system for small libraries using portable data entry terminals similar to those used in bookmobiles. Called the MICRO-1, its memory capabilities will allow transactions to be stored locally for periodic transmission to a remote host computer for file updating and report generation.

We have seen that the micro has many roles to fulfill in circulation control. These roles will be in applications where the micro offers the best solution out of all applicable technologies. The micro is not expected to replace the mini as a central processor in existing inventory control systems. This is not to say that inventory control systems will not eventually be implemented using micros. Different techniques will be required, such as a number of distributed, interactive micros with individual functions.

CATALOGING

Card catalogs have been, and still are for many libraries, the means by which librarians have kept full documentation of their collections. However, as collections grow, card catalogs become unwieldy.

In 1940, Fremont Rider startled the library world when he announced his findings that research libraries grow at an exponential rate and tend to double in size every 16 years. Using the Yale Library as an example, he stated that by the year 2040 it would have 200,000,000 volumes in its collection. If it had a card catalog then, it would have nearly 750,000 drawers and occupy 8 acres of floor space.[8]

Although Fremont Rider's predictions for the Yale Library's collection size are unlikely to materialize, his example shows why a number of libraries are considering closing their card catalogs, or have already closed them. Computerized systems now provide alternatives to the card catalog and often have advantages over

what the card catalog offers. However, online cataloging of individual library collections has not arrived yet. Computers have been used mainly to replicate existing manual systems, and all but a few libraries plan to keep their card catalogs operational at least until 1985.[9]

Requirements of Cataloging

Because libraries are custodians of information, it is important to librarians and patrons alike that accurate, authoritative records exist about that information. The establishment of these records is the responsibility of the cataloging department. Their functions are:

> *To document and list for internal purposes an authoritative record of each item in the collection.*
>
> *To provide a catalog or index which patrons can use to locate desired information about items in the collection.*

The two functions, although related, are quite different. One requires cataloging to standards acceptable to the bibliographic community; the other provides an index of author, title, and in some cases, subject. One is a dictionary catalog, the other an abbreviated catalog.

Automation of the Cataloging Function

Automation of the cataloging function has taken two major paths. On each path, the library generally benefits from someone else's maxi computer.

Automation of the cataloging function has taken two major paths.

The first path has been in obtaining authoritative cataloging information for the dictionary catalog. Either the computer at the Library of Congress, the computer at a national network, or a subscription service has been used to obtain the cataloging information.

The second path has entailed using manual records in the library to generate magnetic tapes of the library's collection. Vendors then use these tapes on their computers to provide the library with microfilms for use as an abbreviated catalog.

National Cataloging Networks

Automation of the dictionary catalog has been made possible for many libraries through national networks such as BALLOTS and OCLC.

These national networks use the MARC II tapes as the foundation of their data bases which are stored in their own maxicomputers. Subscribers can call up the MARC records, or records entered by other subscribers, on a terminal in their own library and edit the information displayed on the screen to suit their own needs. Then, a request can be made for a computer-generated card set from the terminal. Catalog cards are still widely used. In May 1978, OCLC produced an average of 2 million catalog cards weekly.

In addition, OCLC now supplies subscribing libraries with magnetic tapes of the individual library's holdings to produce an automated dictionary catalog. There were almost 4 million records in OCLC as of May 1978, gathered from the MARC tapes plus inputs from over 1400 participating libraries. Therefore, the majority of any library's holdings is likely to be already in the data base. Records not in the data base can be entered by the participating library via its own terminals. Complete tapes can then be processed by an automated catalog vendor into a microform catalog which replaces the card catalog.

There were almost 7 million records in OCLC as of May 1978, gathered from the MARC tapes plus inputs from over 1400 participating libraries.

Computers supporting the cataloging function are also found in large public and academic libraries. These custom-designed systems solve problems associated with card catalogs and large collections. In the majority of cases the computers provided machine-readable data for the production of computer-derived book or microform catalogs.

Automation of Abbreviated Catalogs

Patron or abbreviated catalogs are often produced on computer output microfilm (COM). To produce these catalogs, libraries or their vendors create magnetic tapes containing the information the library desires in its abbreviated catalog. Some vendors supplying this service are listed in Appendix III.

Bell and Howell's Microphoto 16.35 Reader.

Abbreviated catalogs in book form are provided using printers driven automatically by computers. However, because of the expense of producing and maintaining up-to-date versions, many libraries are opting for COM catalogs.[10]

Recent improvements in COM readers, such as the Bell and Howell MicroPhoto 16.35, have resulted in wider patron acceptance of microforms. The catalog is usually updated at regular intervals agreed on by the library and the supplier. Most libraries select reproduction of new microfilms every two or three months.

The Micro and Cataloging

Thus far the micro has filled two major roles in the cataloging area. One is involved with converting existing collections from card catalogs to machine-readable form, and the other involves a turnkey automated cataloging resource system called MINI-MARC.

Conversion Using a Micro

Conversion of dictionary catalogs into abbreviated catalogs can be automatically accomplished using a process called "stripping." A number of libraries including the University of Chicago, the New York Public Library, and the National Library of Medicine have all used micros for this purpose.

A well-publicized example of stripping occurred at the Takoma, Washington, public library when its automated circulation system was installed.[11] The library purchased a magnetic tape containing a data base of 1.9 million titles, typical for a public library, from Blackwell, North America, Inc., which was then stripped to create basic abbreviated records. Using matching techniques based on LC number, ISBN author, or title, the library was able to identify 80 percent of its 250,000 records on the tape. When these records were removed from the tape the library had a machine-readable record of 80 percent of its collection, leaving the remaining 20 percent to be converted manually.

The MINI-MARC Cataloging System

The MINI-MARC system is a cataloging aid which provides a library with an online display of full MARC bibliographic records. The basic system as supplied by Informatics Inc., of Rockville, Maryland consists of a desk-like base containing a Computer Automation LSI-220, 16 bit micro, a CRT display, a keyboard, and a floppy disk unit. A set of 500 floppy disks supplied with the system contains the entire collection of the Library of Congress in machine-readable form.

Once the correct floppy disk is manually installed, any record can be displayed in less than a second. After display, the operator can modify the record as desired before transferring the record onto a blank floppy disk for creation of an individual library's data base. If desired, a record may be displayed with pre-selected fields already stripped. This feature is useful if one is creating an abbreviated catalog from MARC records.

The entire system, plus 500 floppies and one year's maintenance and subscription service for new MARC records, can be purchased for about $45,000. Leases are also available at $960 a month for 5 years, or $1500 a month for 3 years.

The MINI-MARC system has been used to provide abbreviated catalog data for a CLSI LIBS 100 automated circulation system. Using an interface, the data on the floppy disk are transferred to the LIBS 100 data base after circulation functions have finished for the day.

Another feature of the MINI-MARC system is its ability to capture cataloging data in MARC format. Data from any source can be captured and stored permanently on floppy disks, which permits resource sharing of data bases.

The Future of the Micro in Cataloging

Automation of the cataloging function has been very valuable to librarians. However, closer inspection shows that automation has not changed the basic way in which cataloging is conducted. Automation has simply replicated what was already there.

There appears to be no consensus in the library community on how catalog records should be organized in the future.

There appears to be no consensus in the library community on how catalog records should be organized in the future. Until there is agreement, applications for the micro are likely to be minor rather than major. As recently as 1975, there seemed to be uncertainty about the function of cataloging, as reported in the *Journal of Library Automation:*

> *Several individuals expressed concern about confusion in the definition of a library catalog. Most often there was no clear understanding or statement of the definition or purpose(s) of the library catalog.*
>
> *In short, what should, as well as what does a catalog do? Many libraries mentioned this as a major unknown and a major impediment to their future planning.*
>
> *A clear understanding and statement of what a library catalog is would seem to be essential before major changes are planned.*[9]

There is a school of thought which questions why the library needs to have full bibliographic cataloging information in its own data base. Critics concede that a full record may be needed to acquire the book or item (although others are plugging the use of only ISBN numbers for ordering), but once the item is in circulation they assert that it is just as convenient and less expensive to use a service such as OCLC if a full record is required. Detractors agree that OCLC has been a boon to the library, but they say they would be unhappy to have to rely completely on a cooperative service for information. They also point to problems caused by relying too heavily on OCLC.[12]

Inform atics' MINI-MARC system. Operator is shown accepting a floppy disk for insertion into the slots on the left side of the desk.

We may be well into the 1980s before the debate on full bibliographic cataloging is resolved. In the meantime, the micro will continue to be used to solve problems with equipment like MINI-MARC and tape stripping conversion systems.

ACQUISITIONS

The library's acquisitions department handles all work involved after the initial request of library materials is made until the item appears on the shelf for circulation. These activities involve coordinating the activities of many people, expediting, ordering, accounting, and sometimes re-ordering or cancelling orders.

Statistics printed in the 1978 *Bowker Annual* show that public libraries alone purchased 27,578,016 new volumes in 1974. The number of staff required to purchase these volumes was not included, but with manual systems predominating, it is likely to be high.

Acquisitions systems reduce the amount of clerical work required in the ordering department. For example, in 1977 the Buffalo and Erie County Public Library had the staff in the ordering department cut from 25 to 17 people because of a county deficit. Work, however, remained at the same high level and a backlog steadily accumulated.

Automated acquisitions systems reduce the amount of clerical work required in the ordering department.

After installation of an automated acquisitions system, the backlog was cleared and the existing staff became more efficient. It was now possible to handle the workload with 17 people instead of the 25 previously required.

Requirements of an Acquisitions System

There are many different acquisitions systems in use in the ordering departments of our libraries. Despite superficial differences, all systems have these activities in common:

- *receiving initial requests from procurement.*
- *pre-order searching to ensure that the requested item has not already been ordered.*
- *obtaining bibliographic descriptions of the item.*
- *preparing purchase orders for requests.*
- *placing orders with suppliers and determining price and availability.*
- *crediting appropriate accounts.*
- *expediting late orders.*
- *preparing necessary claims.*
- *maintaining on-order files.*
- *receiving deliveries from suppliers.*
- *verifying that the correct item has been received.*
- *authorizing payment from a specific account.*
- *generating statistics on acquisitions.*

With so many diverse, repetitive activities, it is not surprising that some libraries have already automated the acquisitions function.

Types of Automated Acquisitions Systems

There are four types of automated acquisitions systems used by libraries today:

1. *Vendor-supplied online systems.*
2. *Vendor-supplied batch systems.*
3. *Custom-designed systems.*
4. *Acquisitions modules which are part of automated circulation control systems.*

As of June 1978, approximately 200 libraries in the United States were using automated acquisitions systems. The large majority of these are batch systems, although online systems are starting to gain in popularity.

A brief review of all four types of systems will set the background for determining where and how the micro can best serve the acquisitions department.

"Online systems offer the ability to process orders quickly . . . From initial search to printed form, it takes us less than 120 seconds to process an order."

Vendor-Supplied Online Systems

Online systems offer the ability to process orders quickly. A statement made by Earl Kunz, Assistant Head of the Order Department at the Buffalo and Erie County Public Library, which has installed the Brodart online automated Instant Response Ordering System (IROS), supports this:

> *Since January, 79 percent of our books have been ordered through IROS. We're online as much as we can staff the terminals, which usually means 8:30 to 5:00, five days a week. Ten percent of that time is spent in searching; the other 90 percent in ordering. We're printing up about 1,000 order forms a week, pushing orders through the system at a rate of 30 to 35 an hour. From initial search to printed form, it takes us less than 120 seconds to process an order.*[13]

The Brodart IROS system is typical of vendor-supplied automated systems. The computer resides at the vendor's premises, and telephone lines connect terminals in the library to the computer. Other vendors plan to offer online systems to libraries. One example is Baker and Taylor's LIBRIS system. Parts of this system have been demonstrated, although the entire system is not yet fully completed. Highlights of the IROS system given below show the capabilities of an online system.

The IROS System

Brodart's IROS is an online system where a minicomputer (DEC PDP 11/70) is located at the vendor's facility and is operated in a time-sharing mode. As of June 1978, over 650,000 English language monographs were available in the data base for citation verification.

Telenet makes it economical for libraries all over the country to use a communications network without paying expensive toll charges.

Each library has one or more intelligent terminals (Beehive B500) which provide a keyboard and CRT display for staff use. The terminal is connected to the computer by a low-cost telephone communications network (Telenet) which charges only for the time used to transmit data and not by the distance. This feature makes it economical for libraries all over the country to use a communications network without paying expensive toll charges. Also, orders may be transmitted via the terminal directly to Brodart, which eliminates mailing paperwork. An impact printer (Centronics Model 306) automatically prints orders on 6-part forms at a rate of about 120 lines per minute.

A monthly fee of $985 covers the cost for the terminal printer, network communications and the use of computer time.

DATALIB

A different concept has been implemented for federal users by the Sigma Data Corporation of Rockville, Maryland. This concept, DATALIB, is an online acquisition system run on a dedicated DEC PDP 11/70 mini and is shared by a number of libraries. The optimum number per computer is seven. The computer is kept at the vendor's facility and users access the data base from standard terminals in the library. The cost is $25,000 for each of the first two years, with a smaller service fee for subsequent years.

The system operates on a shared basis. Each user has access to bibliographic records entered by any other member. Confidential files which belong to individual libraries cannot, however, be accessed by the other members.

Vendor-Supplied Batch Systems

A number of vendors offer acquisition services to libraries using computers in a batch-mode. Two such systems will be briefly described here. These are the Baker and Taylor BATAB system, which is basically a software package designed to run on a computer belonging to the library or its administration, and the Charles W. Clark (of Farmingdale, N.Y.) system, which is an automated ordering service.

The BATAB System

As of October 1977, there were 51 subscribers to the BATAB system in the United States and Canada. The system has four main features:

1. *Automatic purchase order production.*
2. *Open-order control.*
3. *Fund accounting control.*
4. *An acquisitions history which remains in the computer.*

Baker and Taylor's BATAB system operates in a batch-mode using mini or maxicomputers at the disposal of the local library. Software is written in COBOL. The computer requires 100 K of core storage, and, depending on the size of the library, 34 to 109 M bytes of disk storage.

An order is placed by first recording order information on a book order or material input form. A keyboard, or some other computer input device such as an OCR WAND™, is then used to enter the information into the computer.

Purchase orders are automatically printed by the computer using a high-speed line printer. Orders may be directed to suppliers of the library's choice and do not have to be sent to Baker and Taylor.

Orders sent to Baker and Taylor may be in machine-readable form (on magnetic tape) for processing. Invoice information from Baker and Taylor can also be returned on a magnetic tape to reduce the amount of keyboarding by the library.

System costs for BATAB are $8,000 for the first year, and $1,500 each subsequent year.

Automated Acquisitions

Automated Acquisitions is the title of a batch system operated by the Charles W. Clark Company. This service allows libraries to order new titles from announcement journals such as *Booklist* or *Publishers Weekly*. There are 9 such announcement journals that can be used as sources of orders.

The library identifies the titles desired on a special order form and mails the form to the company. A computer at Charles W. Clark then handles all the paperwork for generating orders, maintaining on-order files, and keeping accounts. Most of the clerical work normally done by the library is transferred to the vendor.

Custom-Designed Systems

Most custom-designed systems are in large universities or public libraries. These systems have usually been tailored to requirements of individual libraries and run on maxicomputers.

Table 4-2 identifies 6 libraries which use custom-designed acquisitions systems. These systems have already been described in other publications and so will not be described here.[14]

TABLE 4-2

CUSTOM-DESIGNED ACQUISITIONS SYSTEMS

LIBRARY	TYPE OF SYSTEM	HOST COMPUTER	DATA ENTRY METHOD
Santa Clara Free Library	Online	IBM 370/155	IBM 2740 Terminal
Stanford University (BALLOTS)	Online	IBM 360/67	Sanders PDS-804 Terminal
Oregon State University (LOLITA)	Online	CDC 3300	CRT Terminal
Massachusetts Central Library Processing Service	Online/ Batch	IBM 370/145	IBM 2260 Terminal Punched Cards
University of Chicago	Online	IBM 370/168	IBM 1050 Terminal
Arizona State University (LAIS)	Batch	Honeywell 200/1250	Punched Cards

Acquisitions Modules

Some vendors of turnkey automated circulation systems promise to provide acquisitions modules which will allow automation of acquisitions. A module is basically a software package which can be added to an existing computer without redesigning the system, which permits the use of the same computer for more than one library subsystem. Some hardware additions may be required, such as terminals or printers, but this will depend on the individual library's requirements.

A module is basically a software package which can be added to an existing computer without redesigning the system.

Although vendors of automated circulation systems have advertised their intention to offer eventually acquisitions modules, most of their design efforts have been in circulation control. As far as we are aware, no recently designed acquisitions module is actually in operation in a library. A few years ago, CLSI sold an acquisitions module to 9 libraries (one is currently being used at the Baltimore Public Library), but it has not offered that module for sale recently. They have, however, accepted orders for their new module which they plan to start installing in January 1979. This module is fully described in literature distributed by CLSI.[15]

Current Micro Uses

A current use of a micro in an automated acquisitions system is in the Beehive B500 intelligent terminal, part of the Brodart IROS system. The micro inside the terminal has been programmed to produce an image of an order form on the CRT screen. The micro can store the information entered on the order form for printing by the line printer or for transmission directly to Brodart. This ability to press one key on the keyboard to finish many tasks or to store information for later retrieval indicates the power of a micro.

To the best of our knowledge this is the only application of micros to the acquisitions function at this time.

The micro inside the terminal has been programmed to produce an image of an order form on the CRT screen.

The Role of the Micro in Automated Acquisitions

At the 1978 Summer Conference of the ALA, Ralph Shoffner of Ringgold Management Systems suggested that once there is agreement between libraries and vendors on what constitutes an automated acquisitions system, the parts common to all libraries could be put on a micro. Mass production of a common micro module would cut costs for all libraries.

With this method, an automated acquisitions system would consist of a standard micro module and additional devices containing all the unique features desired by a particular library. Vendors might well have a series of these devices for different groups of libraries. These devices could contain one or more micros depending on the requirements. Additional devices could be capable of tying into another computer in the library or into a network for sharing resources.

Mass production of a common micro module would cut costs for all libraries.

The Micro as a Problem Solver

Librarians are apparently not yet satisfied with automated acquisitions systems. It is true that these systems reduce the labor of acquisitions, but there are still problems to be solved.

A number of problems were identified at a conference session entitled *Automated Acquisitions: What's Good, What's Bad, What's Missing* at the June 1978 ALA session in Chicago, Illinois.

Some of the problems mentioned at that session are listed here, since it may be possible to solve them with micros.

- Libraries often have to conform to the accounting procedures of another organization and therefore, cannot use the standard packages provided by the computer.
- How much does a book cost? Publishers often don't seem to know until the book is released. Discounts vary between vendors. It was suggested that tables could be kept in the computer which identified each vendor's discounts. No system now has this feature.
- Libraries would like to have access to a vendor's inventory, so that if 10 items were needed and one vendor had only 3, the remainder of the order could be placed with another vendor. Only Brodart, at this time, allows libraries access to their inventories. This feature would eliminate partial orders arriving from vendors and the problems associated with re-ordering and changing records.

- Many libraries in the past purchased automated acquisitions systems mainly to handle the accounting function. Therefore, early systems had more emphasis on finance rather than bibliographic verification. Recent systems have placed more emphasis on bibliographic verification and may be lacking in fulfilling the library's accounting requirements.
- Better statistics are required for control purposes such as a comparison of expenditures between the present and the same time in a previous year.

Possible roles for the micro which emerge from these points are:

1. A micro module could be developed to handle different accounting procedures. This module could operate with a standard automated acquisitions system.
2. Tables on discounts available to a particular library could be retained in a micro for acquisitions purposes.
3. A micro could be designed for the receiving department which would automatically take care of partial shipments and missing items. This small system could tie into the larger system and would monitor the expected delivery of items. It could command the larger system to generate re-orders for partial shipments.
4. A statistical module using a micro could be developed which would keep track of statistics from previous years and present the information in a format useful to the library.

SERIALS CONTROL

Control of serials is a complex problem for libraries, especially those which subscribe to thousands of titles. A serial is a numbered publication which is published at regular intervals. This includes magazines, periodicals and continuations.[16]

Control of serials is a complex problem for libraries, especially those which subscribe to thousands of titles.

The complexity of the problem is illustrated, for example, by a typical university library with annual subscriptions to 25,000 active serials.[17] This may result in 100,000 individual issues, or 300 to 500 copies arriving daily, which must be checked in, cataloged, and distributed. Missing issues must be claimed, damaged issues returned, and subscriptions renewed. At regular intervals, issues have to be bound, and missing or damaged issues replaced.

Further complexities occur when serials change their title names, as many do every few years. Also, publishers in different parts of the country produce serials which have the same name, such as *ENERGY*. Therefore, a request for a copy of the December 1977 issue of *ENERGY* requires ascertaining the publisher's name or the place of publication before the correct issue can be located.

Importance of Serials

In most research libraries, serials are used more than monographs or other library materials. Information in monographs is usually 1 to 2 years old before it gets into print; information in serials is perhaps 1 week to 6 months old, and information in newspapers and reports is usually the most current. Therefore, after newspapers, articles in serials are in high demand as a source of new information.

After newspapers, articles in serials are in high demand as a source of new information.

Serials control systems are designed to control the logistics of obtaining and distributing individual issues of magazines, journals, etc., to patrons. Most public libraries do not have subject access for serials, although many university and special libraries do.

Requirements of a Serials Control System

The requirements of a serials control system are similar to those of an acquisitions system, but with more complex functions such as renewing subscriptions on time and claiming missing issues. The basic functions of a serials control system are:

- *ordering, renewing and cancelling subscriptions.*
- *creating bibliographic records and a catalog.*
- *receiving new issues and claiming missing copies.*
- *preparing a binding schedule to maintain an even workload.*
- *providing subscription information to the accounting department.*
- *printing statistics for management use.*

Computerized Serials Control

Computers have been used for serials control since 1961, mainly in large or university libraries. The Hayes and Becker second edition of the *Handbook of Data Processing for Libraries*, printed in 1974, has an excellent chapter on serials records subsystems in which the maxi computerized systems of 11 large libraries are described. These systems are either online or batch and handle the internal management of serials control. Those wishing to know more about these systems are referred to the Hayes and Becker book.

National Data Bases for Serials

In December 1974 the Council on Library Resources signed a contract with OCLC to use its computer facilities to develop a national Conversion of Serials (CONSER I). In November 1977 the Library of Congress provided management of the program and the name was changed to CONSER II.

CONSER will be a national bibliographic machine-readable data base which contains cataloging information on serials. In 1978 there were just over 200,000 titles in the data base, and designers anticipate between 250,000 and 300,000 by 1982. Over 72,000 of these titles have now been authenticated.

This data base of serials is available online through OCLC. Individual libraries no longer have to create original records. Libraries contemplating automation have a head start because conversion has already been done. Eventually it is hoped that OCLC will carry holding information identifying libraries subscribing to specific serials, which will benefit interlibrary loan applications.

National Network for Serials

A national automated network for serials control is in development with OCLC's serials control subsystem. Three aspects of serials control will maintained by this subsystem: check in, claiming, and binding.

As of 1978, only the check in system is operational. However, because of shortcomings discovered during operation of the check in system, OCLC has suspended use of this feature until design changes can be made.[18]

About 30 libraries were using the system before its use was temporarily suspended. These libraries were able to build online files of their complete holding statements for each serial. This was accomplished via the OCLC terminal located in each subscriber's library. As each new issue was received, information such as title, issue, and date received was entered into the terminal using the keyboard. Files were then automatically updated and a display was shown of the next expected issue number and the date of receipt. Missing issues were identified when the issue number being checked in was not the expected one.

During operation, however, the next expected issue was not accurately predicted in some cases. Also, present search key structures could not always retrieve a record quickly. Therefore, libraries had to maintain a manual cross-reference file to retrieve records. Until these problems are solved, OCLC has placed a curb on the use of the system.

Automated Serials Services

A number of subscription agencies have been offering automated serials services to individual libraries. These services include ordering, billing and, if desired, claiming serials for the library.

Such a system has been designed by the Faxon Company of Westwood, Massachusetts, which, the company claims, is the only fully automated system in the world. Its system uses an IBM 370/145 maxi computer which gives over 18,000 libraries the ability to order, and renew subscriptions to, over 80,000 journals and magazines.

Customer history files are then established so that all transactions are controlled by the computer.

To order serials, the library sends Faxon a list of titles in alphabetical sequence using title numbers as identified in the *Faxon Librarians' Guide*. Upon receipt of the order, the data are entered into the Faxon computer on one of 80 IBM 3270 Video Display Units which contains a keyboard and a CRT. Customer history files are then established so that all transactions are controlled by the computer. Orders are placed and checks written to publishers electronically. The publishers mail the serials to the library. In case of a missing issue, the library notifies a service agent at Faxon, and Faxon uses the computer to produce a claim request which is sent to the publisher. The library is mailed an annual invoice from Faxon for the subscriptions and the agent's service charge.

If desired, a library can supply the order to Faxon on punched cards or magnetic tape. It may request its invoices in machine-readable form. Using this method, libraries can effectively automate part of their serials function without the expense of maintaining their own data base.

Minicomputer Serials Control Systems

There are only a few serials control systems which use minicomputers. These are custom-designed systems such as the online system at UCLA[19] and the serials acquisitions system at the University of California at Berkeley.

So far there are no turnkey serials control systems similar to those designed for circulation systems. However, some manufacturers, such as Systems Control, Inc. of Palo Alto, California, promise serials control modules as additions to their circulation control systems.

So far there are no turnkey serials control systems similar to those designed for circulation systems.

Richard De Gennaro, in the April 15, 1977 issue of *Library Journal*, discussed the need for a minicomputer-based system in his article, "Wanted — A Minicomputer Serials Control System." With the development of CONSER it appears this need could be met with existing technology. However, no one has yet announced any intention of developing an online system for serials control.

A number of libraries maintain serials control by using an existing automated acquisitions system which treats each issue as if it were a monograph. This type of system has limitations, but does allow partial automation of the serials function.

Serials Control and the Micro

Serials control systems which are developed will undoubtedly use intelligent terminals, light pens, or OCR WANDS™. Micros will therefore fulfill a supporting role in those instances.

Libraries which use subscription services still have functions which are not covered by these services, such as registering arrivals, claiming missing issues and arranging binding schedules. Such tasks can easily be performed by a micro-controlled system tailored to a library's needs.

It may be practical to develop a system which uses more than one micro to handle the serials control function. These micros could be connected to form a distributed system where each micro performs a specific portion of the serials check in function.

Another role for the micro may be in providing a serials control module which could be used with an acquisitions system. This module would probably take the form of an intelligent terminal with an OCR WAND™ attachment and would handle all the serials functions not normally covered in an acquisitions system.

In its role as a problem solver, the micro is sure to find applications in serials control systems in the same way that it has already been used in cataloging and circulation systems.

In its role as a problem solver, the micro is sure to find applications in serials control systems in the same way that it has already been used in cataloging and circulation systems.

REFERENCE

At one time the reference department of the library was considered the last place which would use automation. For one thing, transferring all the data in all those reference books into machine-readable language seemed absurd when reference librarians had been trained to locate that information quickly in response to requests.

At one time the reference department of the library was considered the last place which would use automation.

But that was before the advent of online data bases, also referred to as information retrieval systems. These systems enable librarians to perform literature searches by dialing up a maxicomputer and communicating with the computer using a terminal. In most libraries, a library staff member acts as the intermediary between the patron and the computer. A search strategy is devised by the staff and patron working together. They select keywords and appropriate data bases before approaching the terminal. Boolean algebra, linking the keywords with *"and's," "or's,"* and *"not's,"* narrows the search until the most relevant articles or items of interest are determined.[20]

Librarians need extensive training to operate the terminal, to become familiar with the contents and capabilities of the many data bases available, and to devise search strategies for each of the data bases. This training is especially important as there is a financial charge every time the terminal is connected to the computer. Therefore, searches need to be conducted as efficiently as possible, especially when the patron is being charged for the services.[21]

Data Bases

Information is now available in data bases, which are in machine-readable form, from many sources. Private companies have purchased some of these data bases and have obtained permission to re-sell that information on a subscription basis to libraries. Table 4-3 identifies some sample information retrieval systems. For example, Lockheed Information Services of Palo Alto, California, has a system called DIALOG which offers information for sale from over 60 data bases. These data bases are from the fields of science, technology, social sciences and humanities, and business and economics.

TABLE 4-3

SAMPLE INFORMATION RETRIEVAL SERVICES

SERVICE	SUPPLIER	TYPE OF DATA BASES
DIALOG	Lockheed Information Service	Various
ORBIT	Systems Development Corporation	Various
MEDLINE TOXLINE CANCER LINE	National Library of Medicine	Medical
RECON	Department of Energy	Energy and Resources
TECHNOTEC	Control Data Corporation	Source of Technical Expertise
TRISNET	Department of Transportation	Transportation
BRS	Bibliographic Retrieval Service	Various

These data bases are updated at regular intervals, usually monthly, and contain many records. For example, in the DIALOG System, there are five data bases with more than 1 million records each, and 23 data bases each containing between 500,000 and 1 million records.

In the DIALOG System, there are five data bases with more than 1 million records each, and 23 data bases each containing between 500,000 and 1 million records.

A recent addition to DIALOG is the Magazine Index which provides rapid, patron-oriented indexing of more than 350 popular publications. The Magazine Index allows access to all articles in these 350 publications by keywords from author, title or subject. There is also full cross-referencing with "see" and "see also" to aid in locating information which is entered under full subject and name authority control. With this kind of information now available to patrons, demand for copies of magazines, or copies of articles, is sure to increase.

Most of the information in these data bases is recent, and should be considered as an addition to the reference facilities of the library rather than as an alternative.

The Micro's Role in Information Retrieval

Information retrieval systems run on maxicomputers with huge data bases and large memories. This is at the opposite end of the spectrum from micro systems. Therefore, if the micro has a role to play it will be because of the micro's ability to solve problems.

Libraries which have installed and operated information retrieval systems have run into two problems.

Libraries which have installed and operated information retrieval systems have run into two problems. One is that the systems are too complicated to be used efficiently without formal training.[22] The other is that each vendor uses a different method to communicate with the computer. Therefore, someone who is an expert in searching with DIALOG cannot easily operate an ORBIT system without more training.

Providing User-Oriented Systems

Ideally, the patron should be able to use the information retrieval system without an intermediary to help. With systems as they are today this is not possible. However, a micro-based system could be designed to guide patrons through the process.

This type of micro system has been successfully developed for other user-oriented computerized systems. These user-oriented systems are also fun to use. Instructions are easy to follow, and one is generally successful. If mistakes are made, the computer usually informs the user via the CRT display and gives advice on what to do next.

Some of the problems of training have already been addressed by Elaine Caruso at the University of Pittsburgh under a 1976 National Science Foundation grant. Programs have been developed under this grant effort which could be run on micros in libraries to provide training without the expense of being online to a commercial data base.

Micros as Interfaces for Non-Standard Systems

Vendors have developed their systems independently of each other. Therefore, librarians need to be formally trained on each system because each one is different. For libraries with two or more information retrieval systems, there is a tendency to forget some of the applicable codes if one system is not used for a while. There is also the expense of training the same person a number of times for different information retrieval systems.

The Council of Governments (COG) in Washington, D.C. has recognized the problem of non-standard systems and has proposed a cooperative system which uses a central staff to aid librarians in conducting searches. A microcomputer is to be included as part of the COG system to keep track of charges and statistics.

Another way in which a micro might help solve the problem of non-standard systems would be to design a common system which would work for all vendor's systems. One would only have to type in the name of the system being used,(DIALOG, SCORPIO, etc.) and the micro would convert keyboard inputs into the correct format for that system. Using this method, librarians would only have to be trained once, for the same keyboard commands would work for all vendor's systems. The micro, not the library staff, would get the training for six different systems in the form of programming and would automatically do the conversion.

The micro, not the library staff, would get the training for six different systems in the form of programming and would automatically do the conversion.

Making systems more user-oriented and providing compatible systems are two ways in which the micro can solve problems in information retrieval. Other ways may be as part of intelligent terminals, in more complex systems, or as controllers which allow only authorized people to use the systems and charge the expense to their accounts.

As the use of information retrieval systems becomes more widespread, there will be a demand for these systems to become more user-oriented so that patrons can perform their own searches without computer training and extensive knowledge of the many different data bases. Micros can be used to solve these problems by serving as the user interface between the patron and the information retrieval system.

As the use of information retrieval systems becomes more widespread, there will be a demand for these sytems to become more user-oriented.

LIBRARY ADMINISTRATION

A library, like a business, has different departments which require organization and planning. Administrative functions also include accounting, gathering statistics, and preparing reports.

In the business world, computers are used for all these activities. Many libraries already have their paychecks prepared by a county government or a parent institution's computer. Others may have automated personnel records kept by a department outside the library. But there are many libraries which operate entirely on their own with no outside automated help at all. Therefore, as other functions in the library are automated, these administrative operations are sure to consider automating some of their own activities.

Two products using micros should be of interest to the library administration. One is the small business computer; the other is the word processor.

Small Business Computers

Small business computers are designed to handle routine office requirements such as general ledger, accounts receivable, accounts payable, invoicing, purchase order processing, order writing, inventory control, and payroll. These micro-based systems are often modular: each function is separate from the others and need not be purchased unless desired.

Such a system is the System 200 small business system by Basic/Four Corporation of Tustin, California.[23] This system consists of a Basic/Four processor, 32 K byte memory, 10 M byte disk drive, CRT display, printer, and 9 software modules. The cost is $29,000 for the complete system.

For libraries which have their own programming staff, another company, Quodata of Hartford, Connecticut, offers a business computer system for $9,900. This QDP78 system consists of a LSI video display computer (VT-78), which includes a processor, 32 K bytes of memory, a printer, dual diskette drives, and a portable mini-desk. These are just two examples of the many systems that are available.

Libraries and Small Business Computers

Automating administrative functions with specialized small business computers is likely to lag behind automation of the other functions in many libraries because problems in other departments are usually more pressing. However, as automated circulation systems provide statistics on collection usage and as automated acquisition systems supply fiscal reports, the demand for automating the administrative function is sure to increase. This demand will come when it is realized that inputs from the other computers can be manipulated to provide statistics and data for reports or for internal purposes.

Some libraries may decide to put their administrative functions, such as preparing payrolls, writing checks and comparing yearly expenditures, on an existing library computer. Others, for security reasons, may decide to establish a separate system on a business computer. With so many options now available, each library can choose which method is best for its own situation.

Word Processor

Another micro-controlled product likely to find its way into the administrative department is the word processor. A typical word processor consists of a micro, a typewriter, a CRT, a printer and some storage medium, usually a floppy disk or a cassette.

A typical application for a word processor might be typing a form letter. Here, the typist uses the keyboard as a normal typewriter. As the keys are touched, characters appear on the CRT. Errors are corrected on the screen. A command to print produces a typed letter automatically by the printer. At the same time, the letter may be stored on a floppy disk or cassette for recall at any time. For example, the same letter may have to be sent to different people with different addresses. The letter is recalled on to the CRT from the floppy disk, and the necessary changes are made before printing each letter. Since only the changes are entered via the keyboard, the whole letter does not have to be typed again. Vendor letters, patron letters, or other routine typing done by the library could be handled by the word processor.

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Word Processor Potential

The word processor offers more to the library than just a typist's aid. First of all, word processors produce a machine-readable record of documents as they are typed. This means that an entire book can be produced in machine-readable form as it is being written. The second advantage of word processors is that the latest versions can communicate with computers or with another word processor. Therefore communications between two branch libraries, or libraries wishing to share resources, become more automatic.

These applications are unlikely to be implemented in many libraries immediately. The technology is new, and most libraries have more pressing automation requirements elsewhere. But word processing is closely aligned to library automation and will find a natural role once other functions in the library are automated.

Word Processor Market

As of March 1978 there were approximately 300,000 word processors actively in use in the United States. Of those, no more than 3,000 were of the communicating variety. However, most of the 60 vendors[24] supplying this market now offer communicating versions.

As of March 1978 there were approximately 300,000 word processors actively in use in the United States.

A basic word processor costs about $10,000, and the communicating version costs about $25,000. These prices can be expected to drop once the market expands and competition becomes keener.

Micros in the Administrative Department

Micros are likely to appear in the administrative department initially in word processors and then in small business computers.

The non-communicating word processors will be used first as libraries take advantage of this new micro technology. Then, after the communicating versions drop in price, libraries which need to communicate and transfer data between branches, or other libraries, which share resources, will start using these systems.

Small business computers will be another application of micros in the administrative department. The most likely trend here is for individual libraries to develop programs tailored to their own particular needs. These programs can be made available to other libraries who may use them as they are or may modify them as necessary.

AUDIOVISUAL SERVICES

Many libraries in the United States and Canada offer audiovisual (AV) services to their patrons. Some of these libraries are small and have only one person part-time for the AV function. Some libraries have established separate AV departments. For example, the Los Angeles Public Library has a staff of 47 people devoted to the AV function and circulates over 70,000 reels of film annually.[25]

In addition to booking films, some libraries also rent sound projectors and projection screens. Other libraries belong to a cooperative, where resource sharing between members includes films and supplies. This adds to the workload of the AV department and increases the complexity of their work.

Most AV departments still use manual systems to control their audiovisual materials. These manual systems are unwieldy, for very often a request for a film cannot be honored and alternatives have to be found. Sometimes as many as twenty records may have to be pulled before a suitable replacement, available on the dates requested, is located.

Requirements of an AV System

In preparing this report we planned to develop a conceptual system for an AV system using a micro. We talked with Washington, D.C. area librarians in charge of AV departments about the requirements of such a system. We visited existing operations to get a feel for the magnitude of the problem.

In the midst of these activities, we discovered that Research Technology Inc. (RTI), an established AV supplier, had such a system under development. We recognized that there was no value to our proceeding further.

The requirements listed in this section are the ones which we gathered before we discovered the RTI system. Twelve requirements were requested: nine were considered basic, three were considered desirable. The RTI system essentially performs these nine basic requirements:

Automatic check in of AV materials.

Automatic check out of AV materials.

Response to queries in less than 5 seconds.

Display of schedules for each film for the next 60 days.

Automated printout of packing labels, confirmation slips, and statistical reports.

Access to data in the file by the film number in the film catalog.

Ability to maintain a patron file with names, addresses and telephone numbers.

Ability to book duplicate prints of films on a rotational basis to ensure even wear.

Allowance for different lending periods.

Additional desirable requirements are:

Access to the files by film title.

Access to the files by subject.

Calculation of fines for late returns.

Existing Automation

Automated AV systems are in use in large libraries or in school systems. These systems are maxi or minicomputer-based and are usually tailored for the requirements of individual libraries.

Hewlett Packard of Palo Alto, California has a system which is used in the Fairfax County, Virginia, public schools, among others. With this system, high schools can log-on to the computer using terminals and book their own films. This service is being extended to the elementary schools in the fall of 1978.

High schools can log-on to the computer using terminals and book their own films.

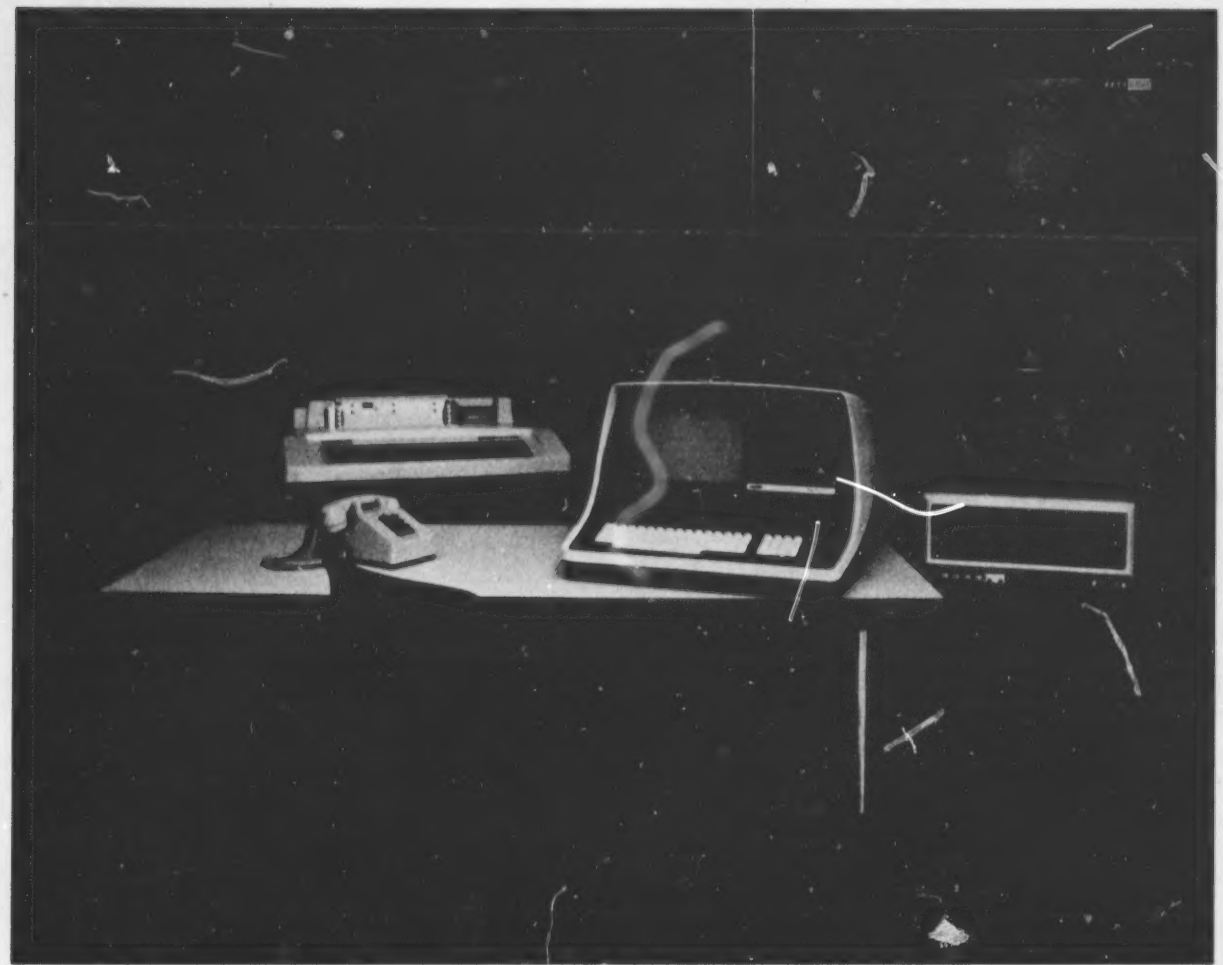
Research Technology Inc. (RTI), of Lincolnwood, Illinois, markets their AUTOBOOK system, a real-time system run on a minicomputer. This system has a number of unique features. One is a modem which is built into every system to allow RTI to perform diagnostics over the telephone from their operation in Illinois. Often it is possible to modify software overnight and have the system operating by the time the staff returns in the morning. Another feature is formal classroom training at the company's plant where users are taught how to maintain and operate the system.

Other libraries have used existing library computers to automate the AV function. The Los Angeles Public Library uses its IBM computers to control its audiovisual materials. The Washington, D.C. Public Library controls its films on its CLSI automated circulation system by treating the films as if they were books.

These existing systems are either too exensive for the majority of AV departments or, in the case of the CLSI users, the system does not provide all the functions desired. Recognizing these factors, RTI has designed a micro-based audiovisual control system which is an industry first.

A Micro-Based AV System

Recognizing that it was to expensive for many libraries, RTI developed the Automated Media Management



Research Technology, Inc.'s AMMS system consisting of a hard copy terminal, a CRT display terminal and a cabinet containing a microcomputer, a disk drive and space for expansion.

System (AMMS) which uses a General Automation 220 micro. Storage of records is on a 10 M byte disk in addition to the 64 K of memory in the micro. The total cost of this micro-based AV system is $48,960. It can be leased or rented at the option of the library.

For the purchase price, the user gets the micro with 64 K of memory, the 10 M byte disk drive, a CRT display terminal, a 100 lines per minute printer, and software. This turnkey system is expandable to four simultaneously operating terminals.

If desired, users can get a complete software documentation package in case the library wishes to add features or modify their system. The programs are written in PASCAL, a high level language.

This system will perform the nine basic requirements listed earlier. Librarians wishing more details about this system should write the manufacturer.

Future Uses of Micros for AV Departments

Micros are likely to be used to develop systems which provide the three additional features not supplied with basic systems. These features are:

- Access to the files by film title.
- Access to the files by subject.
- Calculation of fines for late return of items.

Development of a separate micro-based module which would interface directly with a basic system would give libraries two options to choose from in AV systems. They could choose the basic system or, by purchasing the additional module, they could have the expanded system.

This technique of designing modules, each with its own micro which can be coupled together to provide larger systems, will be invaluable to libraries.

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CONSIDERATIONS BEFORE SELECTING A SYSTEM

This chapter provides general guidelines and information on purchasing a micro-based automated system. Also included are some statistics on market size which may be useful to librarians trying to convince vendors to develop new systems.

Cost

When buying a product, one likes to get value for money. Often, neither the lowest nor the highest priced product is chosen. The lowest priced product may be lacking in quality; the highest priced product may have unwanted features.

It is impractical to talk about cost without discussing performance.

It is therefore impractical to talk about cost without discussing performance. In fact, products which have the lowest initial cost are often the most costly in the long run. For example, over a five-year period, the cost of maintenance and repair of some products can sometimes approach their initial cost.

Performance

Performance of a product can be considered in two ways. One is the product's ability to perform the task to which it is assigned. This aspect is involved with the technical design and determines what the equipment can and cannot do. Some products perform better or worse than others depending on how well or poorly they have been designed.

The second aspect of performance is the product's ability to perform its tasks easily and reliably. There are many technically well-designed products that are unnecessarily complicated to use. There are technically well-designed products which require frequent maintenance. These products were not well-implemented mechanically and cannot operate for long without breaking down. An example of this is the first type of light pens used at the circulation desk. In the earlier nylon-tipped versions, failures were as common as once a month. However, once the nylon tip was removed and replaced with a steel one, failures because of worn tips were eliminated. With a simple change, the quality, and therefore the performance, of the product increased.

Cost/Performance Evaluation

The ideal product is one which provides desired performance at an affordable price.

Micro-based systems will be offered to librarians at costs well below systems which use minis or maxis. They will therefore be attractive as far as price is concerned, but a librarian must also consider performance.

Evaluation of potential library systems in terms of cost and performance is possible using a comparison technique. A table is prepared which lists in appropriate columns: capabilities offered by candidate systems, the library's requirements, and individual vendors' specifications. Then, by eliminating items common to all columns it is easier to compare what is left and to determine which system is closest to meeting the library's requirements. It is also possible to see what one is giving up by going to a lower-cost system or what an extra feature costs.

The ideal product is one which provides desired performance at an affordable price.

Another cost consideration is the practice of certain vendors to finance or rent their systems. Purchase over periods up to five years allows libraries to purchase automation conveniently. Also, librarians can sometimes rent a system before deciding to buy. This option would be ideal where librarians knew they needed automation but were unsure that a specific system might solve their problem.

Purchase over periods up to five years allows libraries to purchase automation conveniently.

Operational Environment

Noisy equipment distracts patrons who come into the library to read or study, so equipment designed for areas frequented by patrons should be quiet. Most micro-based equipment is relatively quiet, but should be evaluated in the library before purchase to ensure that the noise level is acceptable.

Some minicomputer systems require operation in controlled temperatures and are likely to malfunction if the air conditioning fails. Fortunately, micro-based equipment is usually less susceptible to temperature changes, mainly due to its smaller size and lower power requirements. However, the operating temperature range of the equipment should be evaluated by the library staff before purchase of the system.

Electrical Power

Another environmental consideration is electrical power. Libraries have reported problems with their minicomputer systems because of power failures or surges. Librarians should question their vendors about the ability of their equipment to withstand these.

Libraries have reported problems with their minicomputer systems because of power failures or surges.

As micro-based equipment draws much less power than mini-based equipment, it is easier and less costly to design safeguards into the equipment at the factory. Most quality products will have protection against surges, but it is wise to check this before buying.

System Costs

Micro-based systems offer many libraries the ability to automate at costs they can afford. However, some libraries may wish performance which is greater than a micro can supply. Therefore, even though a library can afford the product, it may not be attractive if it does not fulfill all the requirements of that library.

Vendors with existing systems for the library market have priced them at less than $50,000. As competition and sales increase these prices are expected to drop.

Micro-based systems appear to offer the best hope for automating libraries with small collections, such as school libraries.

Micro-based systems appear to offer the best hope for automating libraries with small collections, such as school libraries. A study in the fall of 1974 identified 74,625 schools in the United States with Library Media Centers.[1] Of these schools, 9,072 have enrollments of over 1,000 pupils and typical collections of between 10,000 and 20,000 volumes. A small micro-based system could easily handle these quantities of pupils and volumes.

If 50 percent of these schools (4500) purchased a basic automated circulation system for an estimated price of $5,000 that would be a market of 22.5 million dollars. This illustrates that, with a large number of systems, a manufacturer of a comparatively low-priced system can still generate a large dollar volume.

This is important for libraries to recognize. The cost of automation for all libraries will drop only when many libraries make purchases. Each library that installs an automated system is not only helping itself, it is also making lower prices available for others.

In addition, as vendors sell more systems, they are able to apply new revenue to their research and development programs. This way new products appear and everyone benefits. The cycle starts with the vendor developing the equipment, but it requires purchases by the libraries to continue.

Market Size

Market size is important to vendors since it is one factor in determining the price of new products. If a vendor spends $100,000 to develop a product and anticipates only 10 sales, then at least $10,000 is added to the cost of each unit so that the vendor can recover his investment. On the other hand, if 10,000 sales are anticipated, then only $10 added to each sale would recover the initial investment.

There are at least 32,500 libraries in the United States and Canada, excluding the 74,000 school libraries.[2] The total market size is therefore over 100,000 libraries. Not all those libraries are candidates for automation. Some, of course, are already automated; others are managing very well with their manual systems and see no need for automation. If only 10 percent of the total is interested in automation, that represents 10,000 libraries. If each of those buys only one $30,000 micro system, that will generate sales of $300 million.

An actual example of this is the experience of CLSI with its circulation system. In the year ending June 30, 1978, CLSI's revenues were $7.5 million dollars.[3] Most of these revenues came from 60 libraries which ordered systems the previous year. Since its inception, CLSI has made 98 installations serving 247 libraries. About 180 of those are public libraries.

If only 10 percent of the 16,000 public libraries and branch libraries in the United States and Canada decided to automate, 1,600 will require new systems. If they automated their circulation functions only, it would take CLSI at their present installation rate over 20 years to supply these systems. These numbers show why there are 12 vendors of automated circulation systems vying for a share of the market.

Another way to look at market size is to look at possible revenues which can be generated from servicing a market.

In FY 74, the total expenditure in public libraries for salaries was $587,951,672. If automation has the effect of saving 10 percent of the expenditure for salaries, then a market equivalent to 50 million dollars exists. These figures are 4 years old, so the revenue is now probably closer to $70 million.

There is a healthy market for vendors willing to invest in library automation. The advent of the micro makes it possible to design systems with smaller investments than were previously possible. Therefore, libraries should encourage their vendors to solve library problems using micros.

Negotiating with Vendors

Librarians are likely to have to recommend the purchase of complex library systems to their governing boards. For many, this may be beyond their current experience level. Richard De Gennaro has recognized this problem in an article in the April 1978 issue of *American Libraries*, "Doing Business with Vendors in the Computer-Based Library Systems Marketplace."

Those about to purchase an automated system are advised to read his article for good advice from one who has had experience.

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CHAPTER 6

FUTURE TRENDS FOR THE LIBRARY

This report has focused on the role of the microcomputer in library automation, and how the micro interacts with other technology. This section will continue in that vein by concentrating on the impact the micro and other technology is likely to have on future developments in the library.

New technologies will change an already evolving situation in libraries. Librarians can be excused for empathizing with the Red Queen's statement to Alice in *Through the Looking Glass*, "It takes all the running you can do to keep in the same place." Keeping up-to-date with new technology is bewildering enough for those familiar with the computer industry.

Keeping-up-to-date with new technology is bewildering enough for those familiar with the computer industry.

Acceptance of Computers

Most business communities in the past have accepted computers in three phases. Libraries appear to be following the same pattern.

Phase 1 The computer is used to perform existing functions to save time and money. One example of this is using the computer to generate cards for a card catalog.

Phase 2 The computer is accepted as a help rather than a hindrance and ways are discovered to use the computer to better advantage. An example of this would be computerized cataloging, acquisitions and circulation systems sharing data automatically in the same library.

Phase 3 The computer is used to perform services which are different from those traditionally offered. An example might be delivery of a document in machine-readable language over the telephone or cable TV link from the library to a patron.

Libraries are already in the first phase and some are moving into Phase 2. We will first look at what Phase 2 means to libraries before discussing Phase 3. It is MITRE's belief that the role of the microcomputer will increase as libraries move through the three phases.

Compatible Systems

It was mentioned earlier that for a library to be fully automated there would have to be exchange of data from one system to another. Distributed processing systems using micros will also depend on the computer's capability to transfer data. In order for libraries to move into Phase 2, compatible systems have to be designed and implemented.

In June 1978, Brodart and CLSI announced that their systems were compatible. By using an interface, the Brodart IROS system and the CLSI LIBS 100 System can operate together. Users of CLSI may now gain access to the IROS file and perform searching and ordering functions using the LIBS 100 keyboard. They can also capture bibliographic information from IROS for the LIBS 100 data files for subsequent use in circulation activities. Because of this interface, users do not have to invest in terminals or other equipment to perform the ordering function; they use their LIBS 100 terminals.

Evolution toward Full Automation

The trend towards using interface units to connect systems will continue. It is part of the normal evolutionary cycle that libraries will experience as they move toward full automation.

Systems developed for individual libraries by vendors or by the library community will be tied together in Phase 2. Once these coupled systems are working satisfactorily, total systems will be developed. These total systems will be a move towards full automation of individual libraries at a cost far below what can be achieved today using independent systems.

Organizational and Procedural Changes

Full automation will cause organizational and procedural changes to the library. Traditional boundaries between the various departments will disappear. The trend will be towards a unified structure where each staff member has an intelligent terminal at his or her work station which can access any part of the data base. There may well be files in the computer which follow the traditional departmental lines of today, but those files could be consulted by any member of the staff.

Full automation will cause organizational and procedural changes to the library. Traditional boundaries between the various departments will disappear.

Procedural changes will also take place as ordering will be automatically done by computers, including transferring funds electronically. Also, as books are delivered from the publisher with bar-encoded labels or OCR on their jackets, interlibrary loan will become more automatic because each library will have the same machine-readable number identifying the item.[1]

Statistics provided from the computers will allow librarians to service patrons better. The public will also become more aware of how well the libraries are performing as custodians and circulators of information.

Libraries of Tomorrow

In Phase 3, computers will be used to perform library services which are different from those offered traditionally. Often this may involve new technologies or the marriage of two or more existing technologies.

An example of two existing technologies working together in the future could be a speech recognition system and a microcomputer in an acquisitions system. Instead of having to enter requests and data by keyboards, it would be possible to communicate directly with the computer by speaking into a microphone. Programming could also be simplified using this method, allowing the library staff to create their own programs.

Laser Technology

Laser technology is already used in at least one library product; a laser scanner to read bar-encoded labels at a circulation desk.[2] A micro controls the scanning and the conversion of light reflections into machine-readable data.

Laser technology is already used in at least one library product; a laser scanner to read bar-encoded labels at a circulation desk.

Two other technologies which use lasers are holography and video disks. With the volume of material published increasing, it is obvious that paper is the least desirable medium for storing documents. Methods such as holographic filing and video disk recording promise huge storage capabilities in small volumes.

Holographic filing allows storage of 200 million bits of information in 20,000 individual holograms on a piece of 4 by 6 inch film costing 50 cents.[3] This is equivalent to recording every page in 100 average-sized books on a single page.

With the volume of material published increasing, it is obvious that paper is the least desirable medium for storing documents.

Video disks also promise huge storage capacities; 40 billion bits of information or 54,000 video still frames of pages of books, maps, or photographs on each side of the disk. Current technology allows access to any specific frame within 15 seconds. Access speeds of 1 second are possible.[4]

Micros will be applied in both these technologies because controllers will produce the desired information rapidly from systems containing many holographic films or video disks.

Educational Centers

Technologies which are likely to aid in making the educational functions of the library more powerful and thus more attractive to the public are satellite communications, the formation of library networks, the development of teleconferencing, computer-aided instruction (CAI) systems, and color TV graphics. Some of these technologies like CAI[5] and color TV graphics[6] already use micros to make them portable and cost effective.

Once most libraries install information retrieval systems and patrons become aware of the benefits of computers, it is probable that many of the technologies mentioned above will be introduced into libraries. Each new introduction would expand the capabilities of the library system until all these technologies act synergistically to transform the library into a powerful educational center capable of serving the very diverse needs of many patrons.

Patron Technology

Personal computers are the first step towards computer technology in the home.[7] The telephone could be used to connect the library's computer with a personal computer to browse through the library's collection at home. Automatic ordering and perhaps even delivery are possible.

Controlled-scan television is another technology which could link homes and libraries. Stuart Meyer proposes keeping all library books on the shelves and using controlled-scan to produce copies on audio cassettes for display on home TVs.[8] As the books would never leave the shelves, they would always be available for browsing. If one desired a paper copy from the cassette, a home printer could produce one for personal use. The patron may not be required to return the cassette, which would eliminate circulation as we know it today. Copyright laws would have to be modified to permit such a system, but the idea shows how technology is likely to change traditional library methods.

Predictions have been made that each home television set could be a printing plant by the 21st century at which newspapers, magazines and personal letters could be printed almost instantly and in full color. If this materializes, then libraries could presumably offer the same service to patrons unable to afford such a system. Another prediction is that a small tabletop set would have the information storage capacity of today's neighborhood library and a console model for the home could rival the collection of the Library of Congress.[9]

These predictions may or may not materialize. What is evident is that computers are changing the way in which libraries will do business. The advent of the micro is another step away from traditional libraries and towards some future structure as yet unknown.

Final Review

Information and its accessibility are so important to our society that we are willing to use the best means we know of to assure its availability. For that reason we use our most advanced technology to produce, control, transmit, store and present that information.

We now use computers, cable TV, and satellite communications; and we plan to use holography, video disks, controlled-scan TV, and any other applicable technology to assure us of the best access possible.

In 1978, the micro has emerged as a technology which has cost and performance benefits in library automation. It also has the potential of serving libraries for many years to come. As micro technology advances, libraries will benefit.

In 1978, the micro emerged as a technology which has cost and performance benefits in library automation.

Much has been written in the past about the advantages of full automation in our libraries. Economic factors, such as high system costs, have delayed many of the predictions. However, the micro has brought the cost of automation within the reach of all libraries. Therefore, full automation of our libraries, national networks, and access from home computers are all that much closer.

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APPENDIX I

LIST OF ABBREVIATIONS

ALA	American Library Association
ASCII	American Standard Code for Information Interchange
AV	Audio-Visual
BALLOTS	Bibliographic Automation of Large Library Operations
BATAB	Baker and Taylor Automated Buying System for Libraries
CCD	Charge Coupled Device
COG	Council of Governments
CONSER	Conversion of Serials
CLSI	Computer Library Services, Inc.
COM	Computer Output Microfilm
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DEC	Digital Equipment Corporation
DOE	Department of Energy
EPROM	Eraseable Programmable Memory
IBM	International Business Machines
ICS	Inventory Control System
I/O	Input/Ouput
IROS	Instant Response Ordering System
ISBN	International Standard Book Number
ISSN	International Standard Serial Number
LC	Library of Congress
LIBRIS	Library Information Service
LSI	Large Scale Integration
MARC	Machine-Readable Cataloging
MAXI	Maxicomputer
MEDLARS	Medical Literature Analysis and Retrieval System
MEDLINE	MEDLARS Online
NELINET	New England Library Information Network
OCLC	Ohio College Library Center
MICRO	Microcomputer or microprocessor
MINI	Minicomputer
RAM	Random Access Memory
ROM	Read-Only Memory
SOLINET	Southeastern Library Network
TRS	Transaction Recording System
UTLAS	University of Toronto Library Automated System

APPENDIX II

GLOSSARY OF COMPUTER TERMS

The majority of computer terms supplied in this Appendix have been taken from a *Glossary of Computer Terms*, published by Dataphase Systems of Kansas City, Missouri, in 1978 and used with its permission.

ASCII
(American National Standard Code for Information Interchange, X3.4-1968). The standard code, using a coded character set consisting of 7 bit coded characters (8 bits including parity check). Used for information interchange among data processing systems, communications systems, and associated equipment. The ASCII set consists of control characters and graphic characters.

assembly language
A source language that includes symbolic machine language statements in which there is a one-to-one correspondence with the instruction formats and data formats of the computer.

auxiliary storage
(1) Data storage other than main storage; for example, storage on magnetic tape or direct access devices. Synonymous with external storage, secondary storage. (2) A storage that supplements another storage. Contrast with main storage.

batch processing
(1) Processing of data after a number of similar input items have been accumulated and grouped together. (2) Pertaining to the sequential input of computer programs or data. (3) Loosely, the execution of computer programs serially. Contrast with online processing.

BASIC
An algebra-like language used for problem solving by engineers, scientists and others who may not be professional programmers.

binary
(1) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are two possibilities. (2) Pertaining to the number representation system that has 2 as its base.

binary code
A code that makes use of exactly two distinct characters, usually 0 and 1.

bit
A unit of information content. Contraction of "binary digit," a bit is the smallest unit of information in a binary system of notation. It is the choice between two possible states, usually designated one and zero.

boolean
(1) Pertaining to the processes used in the algebra formulated by George Boole. (2) Pertaining to the operations of formal logic.

bus
A group of parallel lines used to transmit data.

bus standard
A method of defining the characteristics of the BUS.

byte
(1) A sequence of adjacent binary digits operated upon as a unit and usually shorter than a computer word. (2) The representation of a character, a common representation being 8 binary digits equaling 1 byte, which equals 1 character.

cathode ray tube (CRT)
An electronic vacuum tube, such as a television picture tube, that can be used to display graphic images in visual display terminals.

central processing unit (CPU)
A unit of a computer that includes the circuits controlling the interpretation and execution of instructions. Synonymous with main frame.

central processor
A central processing unit.

character
The actual or coded representation of a letter, digit, or other symbol. A character is often in the form of a spatial arrangement of adjacent or connected strokes.

charge coupled device
A solid state memory.

chip
A plastic package with pins protruding from both long sides. Used to house electronic circuits.

compile
To prepare a machine-language program from a computer program written in another programming language by using the overall logic structure of the program, or generating more than one machine instruction for each symbolic statement, or both.

compiler
A program that compiles.

computer
A data processor that can perform substantial computation, including numerous arithmetic or logic operations, without intervention by a human operator during the run.

computer network
A complex system consisting of two or more interconnected computing units.

computer program
A series of instructions or statements, in a form acceptable to a computer, prepared to achieve a certain result.

computer word
A sequence of bits or characters treated as a unit and capable of being stored in one computer location.

computing system
A central processing unit, with main storage, input/output channels, control units, direct access storage devices, and input/output devices connected to it.

console
That part of a computer used for communication between the operator or maintenance engineer and the computer.

conversion
(1) The process of changing from one data processing method to another, or from one data processing system to another. (2) The process of changing from one form of representation to another, e.g., changing from decimal representation to binary.

cross assembler
A computer program assembled on one computer and run on another.

data
(1) A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by human or automatic means. (2) Any representations such as characters or analog quantities to which meaning is, or might be, assigned.

data acquisition
The process of identifying, isolating, and gathering source data to be centrally processed in a usable form.

data base
A collection of data fundamental to an enterprise.

data collection
A telecommunications application in which data from several locations is accumulated at one location (in a queue or on a file) before processing.

data file
A collection of related data records organized in a specific manner. For example, a payroll file (one record for each employee, showing rates of pay, deductions, etc.) or an inventory file (one record for each inventory item, showing the cost, selling price, number in stock, etc.).

data management
A major function of operating systems that involves organizing, cataloging, locating, storing, retrieving, and maintaining data.

decimal
(1) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are ten possibilities. (2) Pertaining to the number representation system with a base of ten.

dial-up
The use of a dial or pushbutton telephone to initiate a station-to-station telephone call.

dial-up terminal
A terminal on a switched line.

digital
(1) Pertaining to the use of discrete integral numbers in a given base to represent all the quantities that occur in a problem or calculation. (2) Pertaining to data in the form of digits. (3) Contrast with analog data.

digital computer
(1) A computer in which discrete representation of data is mainly used. (2) A computer that operates on discrete data by performing arithmetic and logic processes on these data. Contrast with analog computer.

disk pack
A removable direct access storage volume containing magnetic disks on which data is stored. Disk packs are mounted on a disk storage drive.

disk storage
Storage on direct access devices that record data magnetically on rotating disks.

documentation
(1) The creating, collecting, organizing, storing, citing, and disseminating of documents, or the information recorded in documents. (2) A collection of documents or information on a given subject.

downtime
The time interval during which a device is malfunctioning.

dual floppy disk
A device which holds two floppy disks.

electronic data processing (EDP)
(1) Data processing largely performed by electronic devices. (2) Pertaining to data processing equipment that is predominantly electronic, such as an electronic digital computer.

EPROM
An erasable programmable memory. A memory which can be changed using ultra-violet light after being programmed.

emulation
A means of testing a micro-based system.

file
A collection of related records treated as a unit. For example, one line of an invoice may form an item, a complete invoice may form a record, the complete set of such records may form a file, the collection of inventory control files may form a library, and the libraries used by an organization are known as its data bank.

fixed head disks
Disks which use stationary, rigidly mounted reading and writing heads.

floppy disk
A storage medium on a flexible mylar disc, similar in size to a 45 RPM record.

FORTRAN
FORmula TRANslating system. A language primarily used to express computer programs by arithmetic formulas.

font
A family or assortment of characters of a given size and style, for example, 10-point OCR-A.

general purpose computer
A computer that is designed to handle a wide variety of problems.

hard disk
A rigid storage medium for computer systems.

hard copy
A printed copy of machine output in a visually readable form; for example, printed reports, lists, documents, and summaries.

hardware
Physical equipment, as opposed to the computer program or method of use; for example, mechanical, magnetic, electrical, or electronic devices. Contrast with software.

host computer
(1) The primary or controlling computer in a multiple computer operation. (2) A computer used to prepare programs for use on another computer or on another data processing system; for example, a computer used to compile, link edit, or test programs to be used on another system.

information retrieval system
A computing system application designed to recover specific information from a mass of data.

input
(1) Data to be processed. (2) The state or states occurring on specified input channel. (3) The device or collective set of devices used for bringing data into another device. (4) A channel for impressing a state on a device or logic element. (5) The process of transferring data from an external storage to an internal storage.

input/output (I/O)
(1) Pertaining to input or output, or both. (2) A general term for the equipment used to communicate with a computer, commonly called I/O. (3) The data involved in such communication. (4) The media carrying the data for input/output.

interaction
In systems with time sharing, a basic measure of system activity consisting of acceptance by the system of a line of terminal input, processing of the line, and a return of data, if any, to the terminal.

interactive
Pertaining to an application in which each entry elicits a response, as in an inquiry system. An interactive system may also be conversional, implying a continous dialog between the user and the system.

interface
A shared boundary. An interface might be a hardware component that links two devices or it might be a portion of storage or registers accessed by two or more computer programs.

keyboard
A device for encoding data by key depression, which causes the generation of the selected code element.

language
A set of representations, conventions, and rules used to convey information.

Large Scale Integration (LSI)
Complete electronic circuits on a small piece of silicon.

light pen
An optical device for reading bar-encoded labels.

logic chip
An electronic digital circuit inside a plastic housing.

log off
The procedure by which a user ends a terminal session.

log on
The procedure by which a user initiates a terminal session.

machine-language
A language that is used directly by a machine.

machine-readable medium
A medium that can convey data to a given sensing device.

magnetic core
A configuration of magnetic material that is, or is intended to be, placed in a spatial relationship to current-carrying conductors and whose magnetic properties are essential to its use. It may be used to concentrate an induced magnetic field as in a transformer induction coil or armature, to retain a magnetic polarization for the purpose of storing data, or for its nonlinear properties as in a logic element. It may be made of materials such as iron, iron oxide, or ferrite and in shapes such as wires, tapes, toroids, rods, or thin film.

magnetic disk
A flat circular plate with a magnetic surface on which data can be stored by selective magnetization of portions of the flat surface.

magnetic tape
(1) A tape with a magnetic surface on which data can be stored by selective polarization of portions of the surface. (2) A tape of magnetic material used as the constituent in some forms of magnetic cores.

main storage
(1) The general purpose storage of a computer. Usually, main storage can be accessed directly by the operating registers. Contrast with auxiliary storage. (2) All program-addressable storage from which instructions may be executed and from which data can be loaded directly into registers.

maintenance
(1) Any activity intended to eliminate faults or to keep hardware or programs in satisfactory working condition, including tests, measurements, replacements, adjustments, and repairs. (2) See corrective maintenance, file maintenance, preventive maintenance.

maintenance time
Time used for hardware maintenance. It includes preventive maintenance time and corrective maintenance time.

memory
Same as storage. See also auxiliary storage, main storage.

microcomputer
A microprocessor with the addition of Memory, Input/Output circuits and Timing.

microprocessor
A central processing unit containing an Arithmetic and Logic Unit, Control Block and Register Array.

modem
(MOdulator-DEModulator) A device that modulates and demodulates signals transmitted over communication facilities.

network
(1) In teleprocessing, a number of communication lines connecting a computer with remote terminals. (2) The interconnection of electrical components. See computer network.

object code
Output from a compiler or assembler which is itself executable machine code or is suitable for processing to produce executable machine code.

object program
A fully compiled or assembled program that is ready to be loaded into the computer. Contrast with source program.

OCR
See optical character recognition.

OCR-A
The type font approved by NRMA (National Retail Merchants Association) for use with optical character recognition devices.

offline
Pertaining to equipment or devices not under control of the central processing unit.

offline storage
Storage not under control of the central processing unit.

offline system
In teleprocessing, that kind of system in which human operations are required between the original recording functions and the ultimate data processing function. This include conversion operations as well as the necessary loading and unloading operations incidental to the use of point-to-point or data-gathering systems. Contrast with online system.

online
(1) Pertaining to equipment or devices under control of the central processing unit. (2) Pertaining to a user's ability to interact with a computer.

online processing
Processing of input data in random order, without preliminary sorting or batching; contrast with batch processing.

online storage
Storage under the control of the central processing unit.

online system
(1) In teleprocessing, a system in which the input data enters the computer directly from the point of origin or in which output data is transmitted directly to where it is used. (2) In telegraph usage, a system of transmitting directly into the system. Contrast with offline system.

optical character recognition (OCR)
The machine identification of printed characters with light-sensitive devices. Contrast with magnetic ink character recognition.

optical reader
A device that reads handwritten or machine printed symbols into a computing system.

optical scanner
(1) A device that scans optically and usually generates an analog or digital signal. (2) A device that optically scans printed or written data and generates their digital representations.

output
(1) Data that have been processed. (2) The state or sequence of states occurring on a specified output channel. (3) The device or collective set of devices used for taking data out of a device. (4) A channel for expressing a state of a device or logic element. (5) The process of transferring data from an internal to an external storage device.

parity bit
A check bit appended to an array of binary digits to make the sum of all the binary digits, including the check bit, always odd or always even.

parity check
A check that tests whether the number of ones (or zeros) in an array of binary digits is odd or even.

PL/I
A high level programming language, designed for use in a wide range of commercial and scientific computer applications.

port
(1) An entrance to or exit from a network. (2) In data communicaions, that part of a data processor which is dedicated to a single data channel for the purpose of receiving data from or transmitting data to one or more external, remote devices.

preventive maintenance
Maintenance specifically intended to prevent faults during subsequent operation. Contrast with corrective maintenance. Corrective maintenance and preventive maintenance are both performed during maintenance time.

printer
An output device that converts coded input to readable impressions on paper or other media.

program
(1) A series of actions proposed in order to achieve a certain result. (2) Loosely, a routine. (3) To design, write and test a program as in (1). (4) Loosely, to write a routine. See computer program, source program.

programmer
A person mainly involved in designing, writing, and testing computer programs.

programming
Designing, writing, and testing a program.

Random Access Memory (RAM)
A memory which can be "written" into and read out of immediately by means of vertical and horizontal co- ordinates.

Read Only Memory (ROM)
A memory which cannot be "written" into after manufacture. It can only be "read" by the user.

real-time processing
(1) Processing data rapidly enough to provide results useful in directly controlling a physical process or guiding a human user. (2) Pertaining to the actual time during which a physical process transpires.

record
A collection of related items of data, treated as a unit. For example, one line of an invoice may form a record; a complete set of such records may form a file.

recording density
The number of bits in a single linear track measured per unit of length of the recording medium.

register
A device capable of storing a specified amount of data, such as one word.

response time
(1) The time between the submission of an item of work to a computing system and the return of results. (2) In systems with time sharing, the time between the end of a block of user input and the display of the first character of system response at the terminal. Response time includes: transmission time to obtain any file records needed to answer the inquiry; and transmission time back to the terminal.

search
To examine a set of items for one or more with a desired property.

search key
Data to be compared to specific parts of each item for a search.

secondary storage
Same as auxiliary storage.

security
Prevention of access to or use of data or programs without authorization.

simulation
A technique for testing software without a functional system.

software
A set of programs, procedures, and possibly associated documentation concerned with the operation of a data processing system. For example, compilers, library routines, manuals, and circuit diagrams. Contrast with hardware.

solid state
A device which operates using solid state materials such as germanium or silicon.

source language
The language from which a statement is translated.

source program
A computer program written in a source language. Contrast with object program.

stand-alone
A computer which operates without the need for other computers.

storage
(1) Pertaining to a device into which data can be entered, in which they can be held, and from which they can be retrieved later. (2) Loosely, any device that can store data. Synonymous with memory.

system
(1) An assembly of methods, procedures, or techniques united by regulated interaction to form an organized whole. (2) An organized collection of people, machines, and methods required to accomplish a set of specific functions.

tape drive
A device that moves tape past a head. Synonymous with tape transport.

tape unit
A device containing a tape drive, together with reading and writing heads and associated controls. Synonymous with tape deck.

telecommunications
(1) Pertaining to the transmission of signals over long distances, such as by telegraph, radio, or television. (2) Data transmission between a computing system and remotely located devices via a unit that performs the necessary format conversion and controls the rate of transmission.

terminal
(1) A point in a system or communication network at which data can either enter or leave. (2) Any device capable of sending and receiving information over a communication channel.

timing
An electronic clock used for synchronization of events in a computer or other digital devices.

turnkey
A packaged system supplied by a vendor which is completely operative.

type font
A type face of a given size and style, for example, 10-point OCR-A.

update
To modify a master file with current information according to a specified procedure.

voice-grade channel
A channel suitable for transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3000 Hertz.

word length
A measure of the size of a word, usually specified in units such as characters or binary digits.

write
To record data in a storage device or a data medium. The recording need not be permanent, such as the writing on a cathode ray tube display device.

APPENDIX III
LISTS OF VENDORS

Automated Circulation

Vendor	Address	Telephone #
Checkpoint Systems, Inc.	110 E. Gloucester Pike Barrington, NJ 08007	609-546-0100
Cincinnati Electronics	2630 Glendale-Milford Rd. Cincinnati, OH 45241	513-563-6000
CL Systems, Inc. (CLSI)	81 Norwood Avenue Newtonville, MA 02160	617-965-6310
Data Phase Systems, Inc.	Plaza West Center 4528 Belleview Kansas City, MO 64111	816-931-7927
Decicom Systems, Inc.	250 Adams Blvd. Farmingdale, NY 11735	516-293-9270
East Brunswick Public Library	The Library 2 Jean Walling Civic Ctr. East Brunswick, NJ 08816	201-254-1220
Gaylord Bros., Inc.	Box 61 Syracuse, NY 13201	315-457-5070
Knogo/ALS	100 Tec Street Hicksville, NY 11801	516-822-4200
3M Inventory Control System (ICS)	3M Company Library Systems 3M Center, Bldg. 220-9E St. Paul, MN 55101	612-733-2851
Plessey, Ltd.	International Computing 4330 East-West Highway Bethesda, MD 20014	301-654-9120
Systems Control, Inc.	1801 Page Mill Road Palo Alto, CA 94304	415-494-1165
Universal Library System, Ltd.	202-60 Saint Calir Ave. E. Toronto, Ontario, Canada M4T 1N5	416-961-1011
Utlas	University of Toronto 130 George St. Rm. 8003 Toronto, Ontario, Canada M5S 1A5	416-978-7171

Automated Cataloging

Vendor	Address	Telephone #
Autographics Inc.	751 Monterey Pass Monterey Park California 91754	213-269-9451
Baker & Taylor	Eastern Division 50 Kirby Ave Somerville, NJ 08876	201-526-7121

Ballots	Ballots Center Stanford University Encina Commons Stanford, CA 94305	415-497-2300
Bell & Howell	Micro Photo Division Old Mansfield Rd. Wooster, OH 44691	216-264-6666
Blackwell, N.A. Inc.	10300 S.W. Allen Blvd. Beaverton, OR 97005	503-643-8423
Brodart Inc.	1609 Memorial Ave. Williamsport, PA 17701	717-326-2461
Informatics	Informatics 6011 Executive Blvd. Rockville, MD 20852	301-770-3000
Ohio College Library Center	1125 Kinnear Road Columbus, OH 43212	614-486-3661
Readex Microprint Corporation	101 Fifth Ave. New York, NY 10003	212-243-3822

Automated Acquisitions

Vendor	Address	Telephone #
Baker and Taylor	Midwest Division Gladiola Avenue Nomence, IL 60954	815-472-2444
Blackwell, N.A. Inc.	1001 Fries Mill Road Blackwood, NJ 08012	609-629-0700
Brodart	1609 Memorial Ave. Williamsport, PA 17701	717-326-2461
Charles W. Clark Co., Inc.	564 Smith Street Farmingdale, NY 11735	516-694-4666
Washington Library Network (WLN)	Washington State Library Olympia, WA 98504	206-753-5595

Automated Serials

Vendor	Address	Telephone #
FW Faxon Co., Inc.	15 Southwest Park Westwood, MA 02090	800-225-7894
The Magazine Index	885 North San Antonio Rd. Los Altos, CA 94022	415-941-1100

Information Retrieval

Vendor	Address	Telephone #
BRS	Biblographic Retrieval Services Corporation Park, Bldg. 702 Scotia, NY 12302	518-374-5011
Lockheed/Dialog	Lockheed Information Systems 3251 Hanover Street Palo Alto, CA 94304	800-227-1960
SDC/ORBIT	Systems Development Corp. 7929 Westpark Drive McLean, VA 22102	703-790-9850
TECNOTEC	Control Data Corp. 6003 Executive Blvd. Rockville, MD 20850	301-468-8053

Small Business Computers

Vendor	Address	Telephone #
Basic/Four Corp.	14101 Myford Rd. Tustin, CA 92680	714-731-5100
Quodata	196 Trumbull Hartford, CT 06103	203-728-6777

Audio Visual Systems

Vendor	Address	Telephone #
Hewlett Packard	2 Choke Cherry Rd. Rockville, MD 20850	301-948-6370
Research Technology, Inc.	4700 Chase Lincolnwood, IL 60076	800-323-7520

In December 1979, MITRE plans to publish a guide book to assist librarians in the selection and installation of automated systems. Do you wish to be included on our mailing list announcing publication of this guidebook?

yes ☐ no ☐

MICROCOMPUTERS IN LIBRARY AUTOMATION SURVEY

We value your feedback and would therefore be pleased if you would take the time to complete the following questions and return them to:

The MITRE Corporation
1820 Dolley Madison Boulevard
McLean, Virginia 22102
ATTN: Document Control Center

Name: _____ Position: _____

Address: _____

Telephone: ( ) _____

1. Date you received the report: _____

2. How did this report come to your attention? (Check one or more boxes)

   ☐ received order form in the mail
   ☐ read about it in *Library Journal*
   ☐ heard about it from someone else
   ☐ other _____

3. From which of the following viewpoints is your interest in reading this report (check all that apply):

   ☐ librarian ☐ administrator
   ☐ technician ☐ other _____

4. Do you plan to make any use of the information presented in this report?

   yes ☐ no ☐

5. Did you:

   ☐ read the entire report ☐ read very little
   ☐ read only sections of interest ☐ read none

6. To what extent do you believe that this report:

	To a very great extent	To a great extent	To some extent	Not at all
a. is too long	☐	☐	☐	☐
b. is interesting	☐	☐	☐	☐
c. provides enough practical information about microcomputers	☐	☐	☐	☐
d. addresses your needs	☐	☐	☐	☐

7. Does your library have: (check all that apply)

☐ no automation ☐ automation already

☐ plans to automate ☐ no plans to automate

8. Which functions are currently automated, or for which are there plans to automate, in your library? (check all that apply)

	Already Automated	Plans to Automate
circulation	☐	☐
cataloging	☐	☐
acquisitions	☐	☐
reference	☐	☐
administration	☐	☐
serials control	☐	☐
audio visual	☐	☐
other	☐	☐